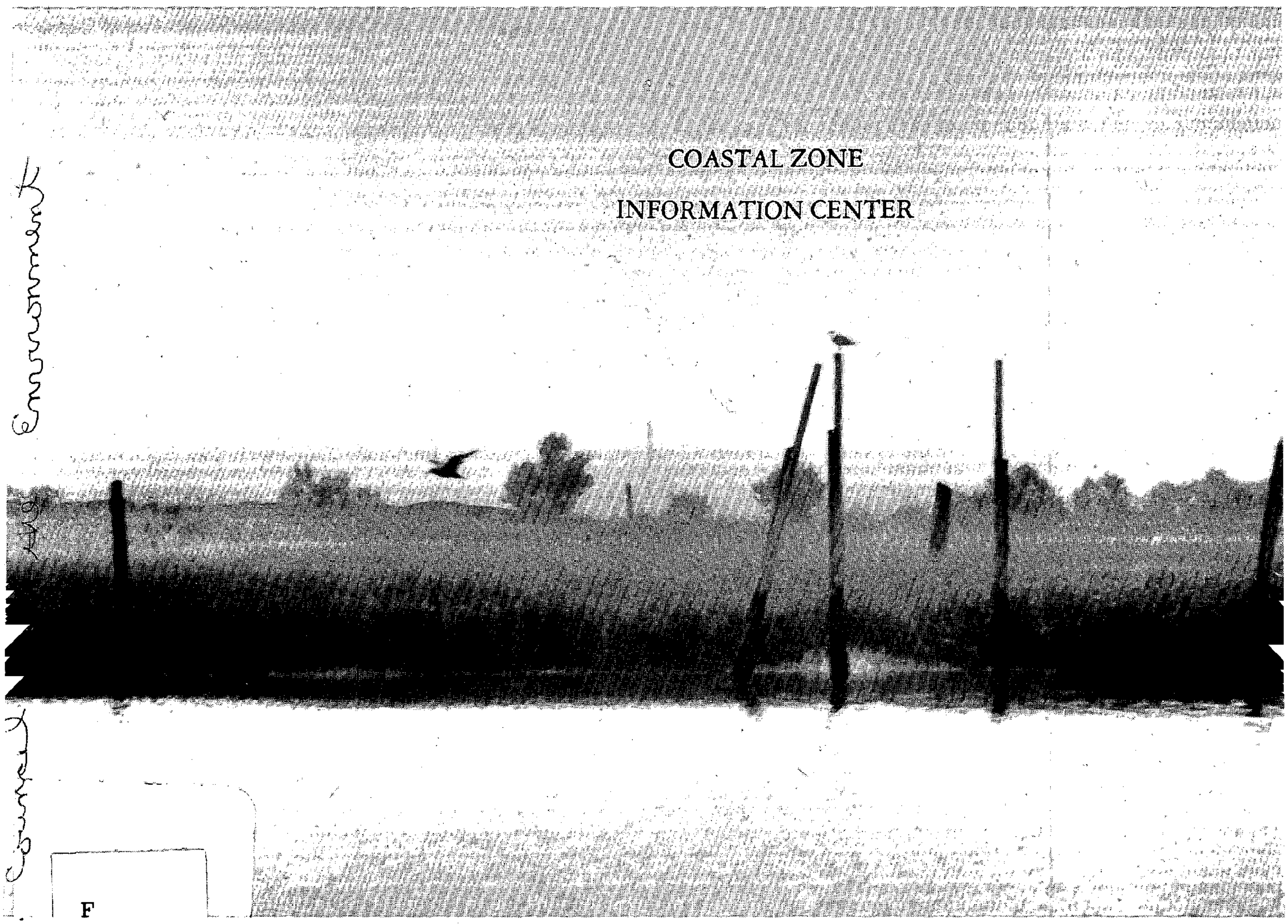
...ogress Report of

...RGINIA'S CHESAPEAKE BAY PROGRAM

...ebruary 1987



...alth of Virginia • Richmond, Virginia

COMMONWEALTH *of* VIRGINIA

Office of the Governor
Richmond 23219

Gerald L. Baliles
Governor

Dear Friends,

Virginia's Chesapeake Bay Program moved steadily ahead during 1986. From across the Commonwealth, citizens both in and beyond the Chesapeake Bay drainage area gave of themselves, their resources and their talents to help our programs succeed.

So, it is a pleasure to present you with our 1986 Progress Report.

Our task is simple: Having now secured momentum, we must now sustain it over the long-term.

I believe we can do it. But it will require hard work and unselfish commitment by all Virginians.

We know the Chesapeake Bay's great value to our Commonwealth. It represents a resource of unparalleled productivity, pleasure and pride. The Bay warrants our best efforts.

Clearly, to restore the Chesapeake Bay to its place of prominence will require generations of support from individuals, interested private organizations and government at all levels.

So, in a sense, today we lay the groundwork for expansion and improvement by our successors. Accordingly, the current biennium state budget provides more than $40 million toward advancing the Bay's management activities. More than 50 percent of those funds will support sewage treatment plant construction.

Of course, from time to time, it behooves us to step back and take an accounting of our progress. Likewise, it is our duty to inform the citizens of the Commonwealth of both our successes and our remaining challenges. Hence, this report.

I hope you will read it with care, because I value your reaction, suggestions and recommendations.

To all who have given their time and talent to this worthy effort, I extend my gratitude. Judging from the broad support the Chesapeake Bay has acquired, I have no doubt that together we will make a difference.

With kindest regards, I am

Sincerely,

Gerald L. Baliles

Progress Report of VIRGINIA'S CHESAPEAKE BAY PROGRAM

February 1987

Council on the Environment
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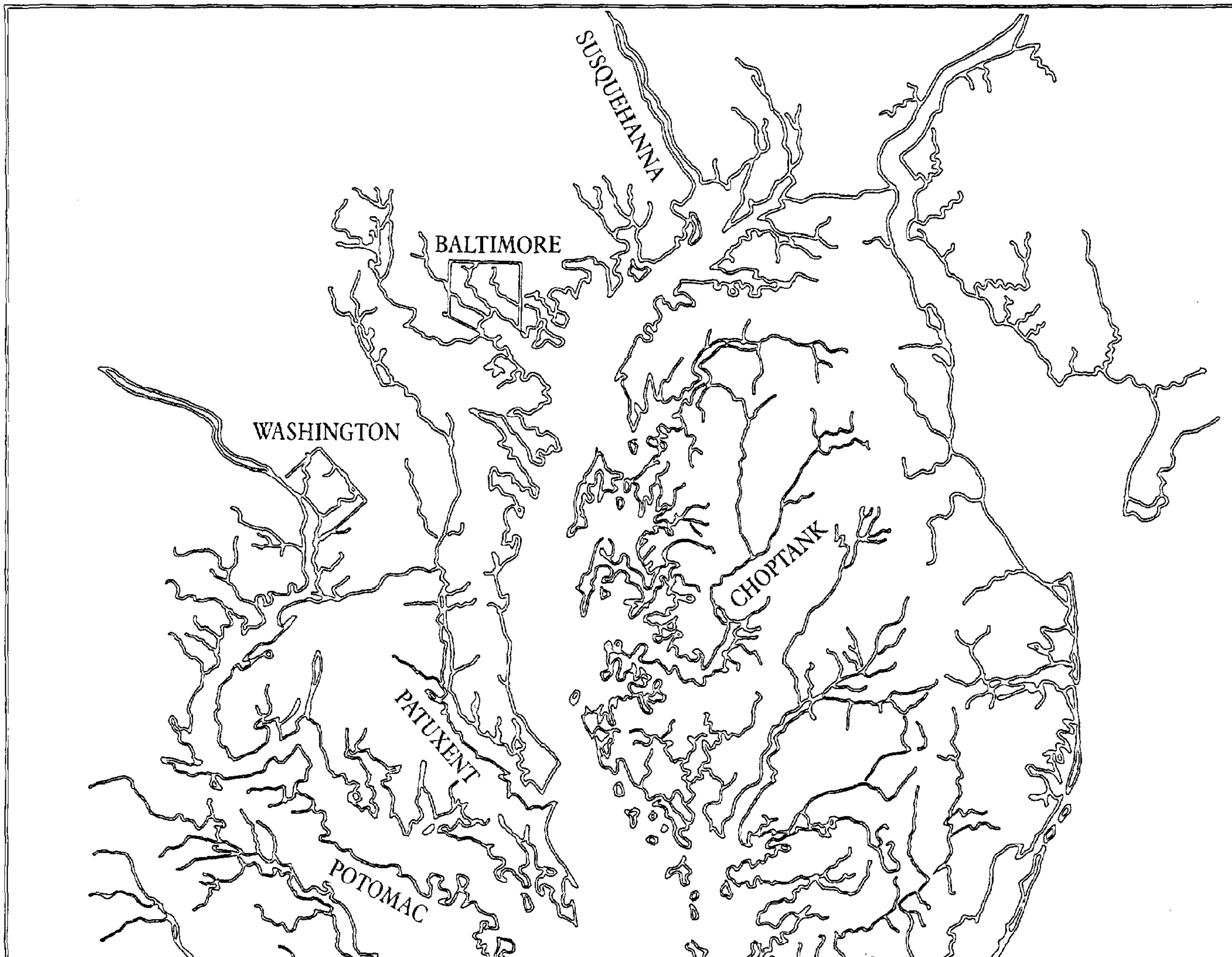
Richmond, Virginia 23219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To the Reader:

This report was produced by the Virginia Council on the Environment as part of its responsibility to coordinate, track and report on Virginia's Chesapeake Bay Initiatives program.

Janice Carter-Lovejoy, Chesapeake Bay Program Coordinator, served as project manager. H. Shepard Moon, Jr., Paul O. Hagenmueller (especially for graphics, layout and design), Catherine Harold, Wanda Ross, Patty Walsh and Gwen Jones contributed.

Other agencies contributing include the Virginia Water Control Board (in particular Robert Siegfried, John Kennedy, and Alan Pollock), Department of Conservation and Historic Resources, Virginia Marine Resources Commission, Virginia Health Department, Department of Housing and Community Development, Virginia Resources Authority, Department of Education, Department of Highways and Transportation, Commission of Game and Inland Fisheries, Department of Information Technology, Hampton Roads Water Quality Management Agency, and the Virginia Institute of Marine Science.

Numerous citizen organizations, other agencies and individuals, in Virginia and elsewhere, also play important roles in the progress reported here.

We are grateful to all who have contributed to this report and to everyone who is helping bring back the Bay.

Keith J. Buttleman, Administrator
Virginia Council on the Environment

Introduction

Virginia is graced with one of the finest natural resources of North America, the Chesapeake Bay. The Bay has served mankind since long before the colonization of the United States, and it has served wildlife for tens of thousands of years prior to man's inhabiting the region.

Today, the value of the Chesapeake Bay is measured in terms of its environmental, recreational, economic, and historical value:

- One of the world's richest sources of shellfish, crabs, and finfish.
- Provides special habitats for overwintering waterfowl.
- Provides numerous opportunities for boaters, sportsfishermen, campers, and nature lovers.
- Over half the annual U.S. oyster catch is harvested here.
- Two of the world's major shipping ports are located on the Bay.
- Has contributed to the heritage of many native American and European settlers.

Many of man's activities have taken a toll on the Bay's resources. Its capacity for renewal is waning in the wake of decades of use and abuse.

By the mid 1970s, signs of stress on the Bay and its resources were noted by concerned citizens and state and federal authorities. Congress authorized the Environmental Protection Agency to undertake an intensive study of the Bay to determine the factors causing its decline. After seven years of research and evaluation, the study results confirmed the hypothesis: the condition of the Bay was deteriorating due to point and nonpoint sources of pollution. (Point source refers to the discharge of wastewater from a specific location like a sewage treatment plant outfall pipe. Nonpoint source refers to runoff from nondiscrete locations such as farms, lawns, and streets.)

The study report documented disturbing trends in three main areas:

• **Excess Nutrients.** Primarily phosphorus and nitrogen, these nutrients can foster the growth of aquatic plants such as algae when present in large quantities. When these blooms die off and decompose they reduce the dissolved oxygen which is critical to the survival of living resources in the Bay's waters. Excess nutrients are coming from a combination of agricultural, forestry, and urban runoff, and municipal and industrial plant discharges. Since 1950, phosphorus and nitrogen entering Virginia's tributaries to the Chesapeake Bay have increased 44% and 87% respectively. If no additional nutrient controls are implemented, these loadings will increase by another 36% and 23% by the year 2000 due to projected population increases.

• **Decline of Submerged Aquatic Vegetation.** Submerged aquatic vegetation (SAV) has all but disappeared in the Chesapeake Bay and its tributaries since the late 1960s. SAV provides fish and crabs essential habitat and protection from predators, buffers wave energy, and produces much needed oxygen for the living resources of the Bay. The decline of these grass beds is attributed to excess nutrients, turbidity, and sedimentation.

• **Excess Toxics.** Large quantities of toxic substances have been found in specific areas of the Bay primarily around urban and highly industrialized areas. Toxics contaminate waters, sediment, and living resources, and have the potential to affect humans as they accumulate in the food chain.

These are but the three most dramatic problems identified in the Bay study. Virginia and the other Bay area states continue to study the Bay to help determine sources of pollution problems and to assist in the formulation of new and alternative solutions to those problems.

In 1984, the Commonwealth of Virginia, along with other states and federal agencies, began a comprehensive effort to bring a halt to the Bay's decline. After only two years of program implementation, cleanup progress cannot yet be measured on any large scale in terms of improved water quality or increased numbers of fish. What can be measured now is the State's successful implementation of new initiatives to tackle the problems, identify alternatives and solutions, provide assistance to localities to abate pollution, and look for ways to revise man's activities which adversely affect the Bay.

This 1986 *Virginia Chesapeake Bay Progress Report* gives a status report of the first biennium (1984-86) of the Chesapeake Bay Initiatives, discusses related coastal issues, and outlines the continuing cleanup program.

Summary of Virginia's Chesapeake Bay Initiatives

Progress to Date

The effort to reverse the long-term decline of the Chesapeake Bay has been a cooperative one involving a wide range of players. Joining the Commonwealth of Virginia in this coordinated effort are the states of Maryland and Pennsylvania, the District of Columbia, and the federal government. In December of 1983 these players entered into the Chesapeake Bay Agreement which called for the preparation and implementation of coordinated plans to improve and protect the Bay. One of the prime products of this interstate effort was the Chesapeake Bay Restoration and Protection Plan which establishes basic goals and objectives and sets out strategies and programs, planned or in place, to improve the Bay's condition. Each state, the District of Columbia, the Environmental Protection Agency, and other federal agencies, developed its own set of initiatives for cleaning up the Bay. The Plan recognizes that bringing back the Bay is a long-term endeavor, one which will take several decades before significant improvements in water quality will be assured.

Virginia has developed an aggressive Initiatives program including 30 projects in nine agencies involving five different cabinet secretariats. Almost $59 million has been committed since the program's inception. This includes $14,937,604 for projects during the 1984–86 biennium and $43,913,589 for 1986–88. Of the funds allocated for 1986–88, $20,400,000 is for sewage treatment plant construction. Overall program coordination and tracking is provided by the Council on the Environment, and program accomplishments are continuously reviewed and documented Bay-wide as well as by river basin.

Many citizen and special interest groups have been involved in the planning, implementation, and monitoring of the cleanup effort from the beginning. As a result, public awareness and support for Virginia's program continues to grow. This, too, will serve Virginia's Bay cleanup effort well over the coming years by helping it to maintain the momentum it now enjoys.

It is important to keep in perspective the fact that it will be several decades before widespread improvements in water quality and living resource populations are evident. Nevertheless, some localized improvements have already been realized in a number of areas. Those accomplishments are noted in this report, along with those efforts which will require a longer period to be truly effective.

Pollution Abatement

The greatest concentration of program effort in Virginia's Chesapeake Bay package includes a variety of individual programs designed to reduce the amount of pollutants entering the Bay and its tributary waters. Virginia is taking actions to reduce nutrient loadings on a large scale, and is dramatically increasing efforts to keep other pollutants out of Virginia's portion of the Bay.

Farms. Pollutant-carrying runoff from agricultural land is being reduced through a combination of education and cost-sharing grants designed to encourage farmers to use "Best Management Practices" (BMPs). During 1984 and 1985, 1,444 farmers installed BMPs on 58,594 acres as a direct result of state cost-sharing funds. From these actions, 333,930 tons of sediment which otherwise would have eroded off farm fields each year will now be retained in place. This also reduces the amount of sediment that would otherwise have actually reached a stream or river by approximately 31,260 tons. Besides reducing sedimentation, the BMPs reduce phosphorus from entering receiving streams. Phosphorus is carried by soil particles; 33,760 pounds of this "hitchhiking" nutrient are now being kept out of Bay and tributary waters. Another 51 farmers are installing facilities to manage 114,407 tons of animal waste each year from their livestock operations, thereby reducing the potential for additional nutrient pollution.

While these figures represent a promising beginning, it is really only a start. There are approximately 24,000 farmers in the Virginia portion of the Bay basin, operating on nearly 3.7 million acres of crop and pastureland. Based on Soil and Water Conservation District (SWCD) estimates, it would take about $170 million in state funds to bring all agricultural acreage and animal operations under BMPs if we rely on cost-sharing alone.

Consequently, the education component of our agricultural runoff control program is especially important, in order to demonstrate to farmers the value of using BMPs and also to convince them to install BMPs voluntarily. The Division of Soil and Water Conservation, along with Virginia Tech, has developed an educational program that illustrates to farmers the benefits of BMPs. There are no guarantees that a farmer will continue to use the BMP in subsequent years, or he may lease his land to another farmer who does not employ the BMP. For these reasons it is imperative that the education component of the BMP program continue each year.

One of the best means of encouragement is by demonstrating the value of BMPs in a clear, convincing way. Virginia Tech developed for the Commonwealth a rainfall simulator for providing such a demonstration. The rainfall simulator, a portable, modified spray irrigation system, creates, over a one-and-a-half acre area, the equivalent of a typical summer cloudburst. It is set up over a test area which contains two side-by-side farm plots, one of which has been conventionally tilled, the other using no-till. By "raining" on both plots equally, under controlled conditions the rainfall simulator provides a graphic demonstration of just how well no-till cropping reduces runoff compared to conventional practices. The runoff from both plots is channeled into two side-by-side flows, in which the difference in clarity (sediment) is clearly visible. One demonstration in Essex County showed the no-till plot to produce half the total runoff, and one-tenth of the sediment, and phosphorus loss and one-fourth the nitrogen loss, when compared with the conventional plot.

The local Soil and Water Conservation District offices and the federal Soil Conservation Service are also helping by providing technical assistance. Together with farmers, management plans are developed or conservation practices are recommended for circumstances particular to individual farms.

According to U.S. Department of Agriculture data, 1985 Virginia cropland under no-till practices had risen by about 7.6% from 1984, and from 58% to 61% of the total acreage planted. Through the education efforts targeted at farmers, including further use of rainfall demonstrations, as well as through the cost-sharing program, Virginia will continue to improve that ratio.

Urban Areas. In urban areas, runoff from streets, parking lots, and other impervious surfaces can carry contaminants into nearby waters. Just as in the case of farmland, certain best management practices can prevent or reduce this form of pollution. While not a major initiative area, the use of urban area BMPs is being encouraged through cost-sharing and technical assistance on selected demonstration sites. Eleven individual projects have been started in 7 localities. These include porous asphalt pavement, an infiltration trench and a grassed waterway, stormwater management, streambank stabilization, and an "urban marsh" and a "wet pond" (manmade rainwater detention basin). Monitoring at the "wet pond" site indicates that it is effective in removing up to 87% of the silt and 80% of the phosphorus from the runoff. It also removes up to 65% of the lead and zinc. While this project is relatively small, its efficiency at pollutant removal is significant. It and other projects serve to demonstrate the urban BMP concepts and promote voluntary use of similar practices in other urban areas.

Sewage Treatment Plants. Other significant sources of nutrients are the 476 municipal sewage treatment plants (STPs) in Virginia portion of the Chesapeake Bay basin. The Virginia Water Control Board estimates a price tag of about $2 billion for the necessary construction, expansion, and improvement in levels of treatment at municipal STPs to carry Virginia to the year 2000; more than half of this need is in the Chesapeake Bay drainage area. In light of this need and the reductions in federal funds available for this purpose, Virginia has become directly involved in the financing of construction and repairs of municipal STPs. Prior to this, the majority of funding for such projects came from a federal construction grant program and some local sources.

Beginning in the 1986-88 biennium, the newly-created Virginia Water Facilities Revolving Fund makes available to localities construction loans at low interest rates. A limited amount of grant funds are also available and targeted for localities with a limited ability to pay. It is likely that a locality could design a financing package involving a loan from the Revolving Fund and/or bond financing through the Virginia Resources Authority.

The Virginia Resources Authority was created by the 1984 General Assembly in order to provide low-interest financing alternatives to localities to fund or refinance water, wastewater, and drainage facility projects. Three financings (bond issues) have taken place to date for a total of $63,620,000. Of the nine localities which have participated, six are within the Chesapeake Bay drainage area.

Other programs are underway to upgrade STPs, to reduce nutrients and chlorine discharged by STPs, as well as reduce sewerline infiltration and inflow problems (I&I). Fourteen municipal sewage treatment plants are scheduled to reduce or eliminate chlorine, ten with 1984-86 Chesapeake Bay Initiatives funds, the other four with 1986-88 funds. Eliminating the 40 infiltration and inflow problem areas existing in the Bay basin should result in significant reductions in the number of occasions that rainfall causes STP overflows and the discharges of untreated sewage into the Bay and its tributaries. Four I&I projects are currently underway with another six planned for fiscal year 1986-87 with the assistance of Initiative cost-share grants.

During the second year of the 1984-86 biennium, the Commonwealth instituted a pilot nutrient removal program. Grants were awarded to three localities to evaluate the costs and effectiveness of removing phosphorus and nitrogen at sewage treatment plants. Operations began in Fall 1986; preliminary results from the York River STP biological nutrient removal process indicate the level of phosphorus discharged has been reduced by more than 75%, from 8 mg/l to less than 2 mg/l.

During the 1984-86 biennium, the State has made significant strides in reissuing discharge permits so that the limitations imposed on treatment plants remain current. In addition, a State standard for chlorine has been adopted, and efforts are underway to develop nutrient standards and toxicity reduction strategies. The combined results of these regulatory programs and the financial assistance programs will contribute dramatically to the abatement of point source pollution in the years to come.

Living Resources and Habitat Improvement

A number of Virginia's Chesapeake Bay Initiatives have a continuing direct effect on marine habitat in the Bay and its tributary waters and complement on-going programs such as the management of tidal wetlands and subaqueous lands.

Chlorine removal or reduction. One effort is directed towards reducing the amount of chlorine used and discharged by sewage treatment plants (STPs). Chlorine, used as a disinfectant by STPs prior to discharging wastewater to the rivers, is acutely toxic to marine organisms, especially fish and oyster larvae. To address this problem, spawning areas of critical finfish populations and important shellfish areas have been identified and a program to reduce chlorine yet maintain a level of disinfection adequate to protect public health has been initiated. Localities with STPs adjacent to sensitive spawning and growing areas are being targeted for participation in the State's cost-share grant program to reduce the amount of chlorine being discharged. The cost-share program is really just an incentive to speed up chlorine control since the Virginia Water Control Board has adopted a water quality standard for chlorine. (See *Chlorine Standard* in the *Bay-wide and Coastal Issues* section of this report.)

For the 1984-86 biennium, ten localities were awarded cost-sharing grants totaling $1.8 million for either dechlorination or alternative disinfection at their sewage treatment plants. Another $1.7 million has been allocated for 1986-88 with four more projects approved to date. Other localities are reducing chlorine voluntarily, or under order in conjunction with state discharge permits. These actions will result in a 36% overall decrease in the amount of chlorine discharged to the Bay from Virginia tributaries. Prior to the Bay cleanup effort, 6670 lbs. of chlorine were being discharged each day; this amount will be reduced to 3905 lbs. per day. Because many of the localities reducing or eliminating chlorine in STP discharges are adjacent to spawning and nursery areas, an increase in fishery populations is anticipated as the young marine organisms reach maturity.

Finfish. Another effort to protect important commercial and recreational fisheries has been the development of fishery management plans. Plans set goals and objectives and include strategies for increasing available stock, improving habitat, managing harvest, and ensuring the proper collection of fisheries data. The first plans to be developed are for striped bass and oysters.

The State's agricultural cost-share program is also having direct impacts on marine habitat. 333,930 fewer tons of soil are eroding from farmland in the Bay basin as a result of new best management practices employed by farmers in 1985. In addition to keeping excessive nutrients out of the water, soil retention directly reduces the siltation of river bottoms, the burying of submerged grasses and bottom dwelling organisms, and decreases turbidity allowing better light penetration which is essential to good submerged aquatic vegetation growth.

Submerged Aquatic Vegetation. Beds of submerged aquatic vegetation (SAV) were once common features of the many shoal areas along the tributaries and Bay. An extensive experimental program was started in the first biennium to reestablish SAV beds and determine what causes their decline. Fifteen acres of eelgrass were transplanted to 10 locations in the Bay tributaries in the fall of 1984. Transplant survival ranged from moderate to poor. Losses are attributed to winter ice scour, turbidity, accidental dredging, cownose ray and crab uprootings, and other biological factors under investigation.

Another 15 acres were transplanted into 11 plots in four river systems in the fall of 1985, primarily in those areas where previous success had been demonstrated. As of June 1986 survival rates ranged from 10% to 75%. Growth in some areas has been phenomenal where at one site each transplanted plug has expanded an average 100-fold. Efforts to reestablish SAV beds, including using seeds in the planting process, monitoring of the key environmental parameters, and refinements of a conceptual model on eelgrass growth, are continuing in the 1986-88 biennium.

Artificial Reefs. Artificial fishing reefs continue to be constructed in order to create habitat to attract and increase the production of recreationally important fish species. This program began in the mid-1970s and was funded with unrefunded motor fuel taxes, but with specific funding through the Chesapeake Bay Initiatives, the amount of reef material deployed increased by about 40% in each year of the biennium.

Three reef sites continue to be added to each year: Parramore Reef—off the Wachapreague Inlet, Tower Reef—east of the Chesapeake Bay Light Tower, and Triangle Reef—east of Cape Charles. Other experimental reef sites are located in the Chesapeake Bay near Gwynn's Island and Cape Charles, and another in the Atlantic Ocean south of Wachapreague.

Shellfish Grounds. Virginia has led the nation in the production and export of shellfish in the past, but generally declining production threatens that prominent position. A variety of natural causes, such as predators and diseases, have been partly responsible. A substantial portion of Virginia's productive shellfish waters have been closed for public health reasons, however, due to their contamination with high bacterial levels, usually associated with domestic sewage.

By 1982, over 91,000 acres of productive shellfish grounds had been permanently condemned due to contamination, out of the 450,000 total acres of leased and public grounds available. As a result of the Chesapeake Bay Initiative program, however, Virginia has taken aggressive action to reverse this situation. Besides maintaining its firm commitment to protect the public health from contaminated seafood, the State is also working to reopen condemned shellfish grounds by correcting the causes of the contamination through the Shoreline Residential Sanitation Program and the Shellfish Enhancement Task Force.

This has been one of the most rewarding developments of the Chesapeake Bay Initiative program, and one that has shown dramatic results since its inception. Early in the process, the Virginia Marine Resources Commission reviewed all condemned shellfish areas and gave them priority ranking according to their value for shellfish production. Independently, the Health Department ranked areas in terms of their sources of contamination and the likelihood of their responsiveness to corrective actions. Sources of pollution include faulty septic tanks and pit privies, animal waste, industrial waste, sewage discharges, and marinas, among others. When the rankings of the two agencies were combined, the result was a priority ranking by both productivity and ease of cleanup. The State was then able to target its available funds to those areas where they would be most effective.

During the 1984-86 biennium, plus the first few months of 1986-88, 3,740 acres of productive shellfish grounds have been reopened, making available to commercial harvesting $1,288,288 in shellfish the first harvest year. If grounds are managed well, these areas should continue to produce shellfish valued at about half this amount in each year thereafter. The cost to the state has been $115,016, for an overall benefit-cost ratio of about 11 to 1. Another 756 acres with an estimated market value of $650,000 have tentatively been reopened under carefully monitored conditions.

A significant element of this program has been that once sources of contamination were identified, enforcement action was sufficient, in many cases, to correct the problem at no additional cost to the state. In addition to the 3,740 productive acres reopened, another 247 acres that are not now productive have been reopened, all through enforcement. Now that they are available, some of these acres could become productive in the future if developed by leaseholders.

Numerous areas remain condemned to shellfish harvest. In the first two years of the Chesapeake Bay Initiatives, those areas with easily identified problems were corrected first; those remaining will therefore be more difficult. In many of the remaining condemned areas the sources and causes of pollution are unknown. And in some cases reliable methods to identify and correct the problems range from poorly understood to non-existent. Figure 1 shows the location of shellfish reopenings; Table 1 lists them by name, area, cost to the state, and market value.

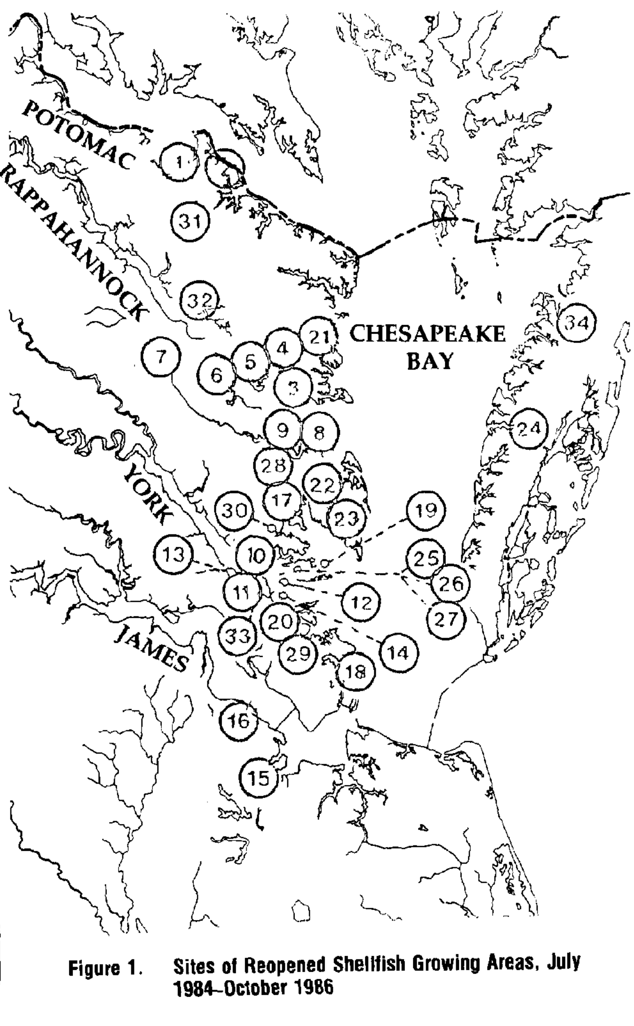


Figure 1. Sites of Reopened Shellfish Growing Areas, July 1984–October 1986

Table 1. Shellfish Bed Reopenings July 1, 1984 through October 6, 1986.

	Acreage Opened	State Initiative Cost	Market Value
Potomac River			
1. Buckner Creek	67	$ 0	$ 5,200
2. Jackson Creek	60	0	52,000
Rappahannock River			
3. Carter's Creek	154	14,250	80,113
4. Corrotoman River	107	0	78,000
5. Greenvale Creek	53	0	3,250
6. Lagrange Creek	149	0	10,000
7. Parrotts Creek*	17	0	1,300
8. Sturgeon Creek	41	0	58,500
9. Mill Creek	21	0	5,200
York River			
10. Cedarbush	28	0	3,250
11. Felgates Creek	63	0	6,500
12. Sarah Creek	104	11,962	7,800
13. York at Cheatham Annex	134	0	10,400
14. York at Gloucester Point	54	0	3,900
James River			
15. Nansemond River*	455	57,995	130,000
16. Pagan River and Jones Creek	166	0	195,000
Minor Tributaries and Embayments			
17. Back Creek*	28	0	325
18. Back River at Harris River	145	0	37,000
19. Brown's Bay	346	27,679	69,500
20. Chisman Creek	158	0	10,700
21. Dividing Creek	91	0	2,600
22. East River	95	0	13,000
23. Horn Harbor**	77	630	129,350
24. Occohannock Creek*	160	0	1,300
25. Severn River at Haywood Creek**	52	0	1,300
26. Severn River, N.W.**	113	0	2,600
27. Thornton's Creek**	21	0	5,200
28. Upper Piankatank	433	2,500	63,700
29. Upper Poquoson River	254	0	300,000
30. Ware River at Wilson Creek**	94	0	1,300
TOTALS	3,740	$ 115,016	$ 1,288,288

An additional 247 acres have been reopened in five other areas whose current productivity is unknown or nonexistent:

31. Lower Machodoc Creek, Potomac River, 60 acres
32. Farnham Creek, Rappahannock River, 71 acres
33. Indian Field Creek, York River, 76 acres
34. Hunting Creek, Eastern Shore, 40 acres

*Reopened since July 1986.
**Off Mobjack Bay.

Oyster Rock Repletion. Meanwhile, another initiative has expanded the existing oyster repletion program to enhance the oyster industry in areas where production is on-going. Oysters depend on the availability of suitable bottom conditions in order for larvae to have a place to "set." One of the best substances for oyster larvae to set on is other oyster shells, but large scale harvesting, as well as siltation, has severely reduced the available oyster shell bottom in most areas. Therefore, the Virginia Marine Resources Commission (VRMC) has for many years planted oyster shells at appropriate locations. The Commission has also relocated seed oysters (very young oysters) to further encourage oyster development where natural set may not be sufficient. Since 1971 there has been a very strong correlation between VMRC repletion program shell planting and the subsequent harvest of marketable oysters three to five years later. This Chesapeake Bay Initiative added $1,000,000, or an increase of 50%, to the repletion program for the 1984-86 biennium enabling the Commission to plant approximately 3.8 million bushels of shell and 66,500 bushels of seed oysters by the end of 1986. There are plans to plant another 2 million bushels of shell in each year of the 1986-88 biennium as well as develop alternative methods of supplying shell for repletion.

Oyster Hatchery. The Virginia Institute of Marine Science (VIMS) has also been heavily involved in the restoration of the oyster industry with a major research project on seed oyster production and distribution. In the fall of 1985, VIMS began operation of an oyster hatchery which will in future years help ensure availability of seed oysters. The hatchery will produce eyed-larvae (those mature enough to attach to a substrate) for remote setting by oystermen as well as for scientific research. So far, 221 million oyster larvae have been raised for in-house research and for industry use.

Research

Oysters. The Virginia Institute of Marine Science is studying the factors and processes influencing the productivity of the James River seed oyster beds. Water circulation studies suggest that these complex patterns play a vital role in the life cycle of the oysters. Beginning in 1987, these findings will be used in a three-dimensional model to help assess the impact of spoil island development and dredging on the oyster beds. Eventually, the model will be used to predict the movement of oyster larvae.

Finfish. Many factors affect the numbers of fish in Bay waters. Studies were undertaken to determine the trends and cyclic components of juvenile fish recruitment to the Bay, together with the climatological factors which may influence their populations. The viability of striped bass eggs in the Pamunkey River was also monitored. Egg mortality is a reliable indicator of spawning activity. Egg viability will be assessed again in 1987 as it indicates trends in the future size of fish populations.

Numerous other research projects are on-going including the analysis of water quality and living resource monitoring data. The findings of these studies are coordinated and shared throughout the state and Bay region.

At the end of the program's first biennium we can see measurable accomplishments in many areas. With continued growth, awareness, and acceptance of the program by the public, and the concerted effort by all concerned parties we will be able to reverse the Bay's decline and ensure its productive future.

Virginia's Chesapeake Bay Initiatives: 1984–86 Expenditures, 1986–88 Appropriations, and Results to Date

The Commonwealth of Virginia embarked upon a comprehensive, long-term program to revitalize the Bay. During the 1984-86 biennium, $14,937,604 million was spent for Bay cleanup initiatives. For the 1986-88 biennium, Virginia has appropriated $43,913,589 million for Bay initiatives. These initiatives include:

	1984-86 Funds *	1986-88 Funds **
Nonpoint Source Pollution Control		
● Adoption of Agricultural Best Management Practices (BMPs), in order to:	$5,455,130[a]	$6,764,651[b]

- Reduce the amount of sediment and nutrients entering the Chesapeake Bay by providing cost-sharing grants to farmers for implementing certain BMPs such as contour farming and no-till planting;
- Educate farmers and others about the water quality and soil retention benefits of BMPs;
- Monitor the impact of cropland and livestock BMP implementation on small watersheds;
- Develop methods for identifying target farms and critical watersheds;
- Provide grants to Soil and Water Conservation Districts to employ technical assistants for BMP installation and program administration.

RESULTS TO DATE

- *1444 farmers participating.*
- *BMP, installed on 58,594 acres.*
- *333,930 tons of soil kept in place.*
- *33,245 pounds of phosphorus kept out of Bay.*
- *111,040 tons of animal waste managed.*

[a]Includes EPA grants of $3,050,004.
[b]Includes EPA grants of $4,162,950.

● Demonstration of Urban Nonpoint Source Pollution Control Projects (urban BMPs), in order to:

- Demonstrate and monitor the effectiveness of certain innovative urban BMPs at controlling erosion and sediment;
- Assess their practicability by cost-sharing with localities for BMP implementation;
- Provide grants to localities for technical assistance for urban runoff control projects.

RESULTS TO DATE

- *11 demonstration projects in 7 localities.*
- *projects include porus pavement, infiltration trench, grassed waterway, stormwater management, streambank stabilization, "urban marsh" and "wet pond" (retention basin).*
- *"wet pond" shown to remove*
  87% of silt
  80% of phosphorus
  65% of lead & zinc

*Indicates expenditures
**Indicates appropriations including carry overs from 1984–86

Point Source Pollution Control

	1984-86 Funds	1986-88 Funds
● Reduction of Chlorine Discharged by Sewage Treatment Plants (STPs), in order to:	$ 39,565	$ 3,355,348[c]

- Improve shellfish and finfish populations by reducing the amount of chlorine (disinfectant) discharged by STPs into spawning areas of rivers;
- Provide cost-share grants to localities to add dechlorination technologies or to apply alternative disinfection methods;
- Continue on-going state action encouraging voluntary monitoring of chlorine levels at STPs.

RESULTS TO DATE

- *Chlorine standard adopted.*
- *10 local projects funded in 84-86*
- *4 approved so far in 86-88*
- *When completed, 36% decrease in chlorine discharges to bay (from 6670 lbs./day to 3905 lbs./day).*
- *Fish survival & reproduction will be enhanced due to chlorine removal in critical habitats.*

[c]Includes $1,660,394 carried forward from 1984-86.

	1984-86 Funds	1986-88 Funds
● Correction of Sewerline Inflow and Infiltration, through cost-share grants to localities, to rehabilitate deteriorated sewerlines, in order to:	$ 344,296	$ 1,596,897[d]

- Reopen shellfish beds, enhance growth of submerged aquatic vegetation, and improve aquatic nursery grounds by reducing the amount of untreated sewage entering rivers; (Water, other than wastewater, which enters a sewage system through defective pipes, joints, or manholes is called infiltration. Inflow is water, other than wastewater, which enters the system through direct connections such as rain gutters or sump pumps).

RESULTS TO DATE

- *4 projects underway in:*
  Colonial Beach–20% of problem solved
  Fredericksburg–7% of problem solved
  Gloucester Co.–40% of problem solved
  Onancock–35 to 40% of problem solved
- *6 projects scheduled in:*
  Kilmarnock
  West Point
  Fredericksburg
  Newport News
  Suffolk
  Colonial Beach

[d]Includes $104,817 carried forward from 1984-86.

	1984-86 Funds	1986-88 Funds
● Creation of Virginia Resources Authority, in order to:	547,300	0

- Relieve some of the future capital needs for water and wastewater treatment by providing a bond market for communities so that facilities can be financed at lower interest rates.

RESULTS TO DATE

- *$63,620,000 worth of bonds issued.*
- *6 out of 9 localities participating are in Bay watershed.*

	1984-86 Funds	1986-88 Funds
● Development of a Computerized Toxics Data System, in order to:	345,140	746,292

- Develop advanced technologies for detecting and analyzing toxics in Bay tributaries, beginning with projects in the James and Elizabeth Rivers.

RESULTS TO DATE

- *Sediment and water samples collected at 40 discharge sites*
- *Shellfish samples collected at 16 sites*
- *Analysis shows most samples exhibit multi-source contamination; however,*
- *Some contaminants can be traced to specific sources.*

	1984-86 Funds	1986-88 Funds
● Demonstration of Nutrient Removal at Sewage Treatment Plants, in order to:	0	360,000[f]

- Gain information on the reliability, operation, and costs associated with nitrogen and phosphorus removal technologies by providing grants to localities to implement these techniques.

RESULTS TO DATE

- *Projects underway at*
  Fredericksburg–simultaneous precipitation
  HRSD-York River–biological nutrient removal
  Kilmarnock–biological nutrient removal
- *Preliminary results at York River STP show phosphorus reduced by more than 75% (from 8 mg/l to less than 2 mg/l).*
- *Modest additional cost.*

[f]Includes $360,000 that is being carried forward from 1984-86.

Resource Improvement

	1984-86 Funds	1986-88 Funds
● Replenishment of shellfish growing areas by transplanting clean oyster shell to provide a good place for oyster larvae to "set."	$ 1,000,000	$ 1,250,000

RESULTS TO DATE

- *3.8 million bushels of shell planted in 1984-86 (up from approx. 2 million bushels for 82-84).*
- *4 million bushels projected for 86-88.*

	1984-86 Funds	1986-88 Funds
● Development of a pilot oyster hatchery to test techniques for the controlled production of seed oysters.	292,557	346,443[g]

RESULTS TO DATE

- *221 million oyster larvae raised for industry and in-house research.*

[g]Includes $46,443 carried forward from 1984-86.

	1984-86 Funds	1986-88 Funds
● Opening of shellfish grounds closed as a result of deficient shoreline residential sanitation facilities by providing grants to low income residents for the correction or installation of facilities.	260,000[h]	300,000

RESULTS TO DATE

- *3740 acres of productive shellfish grounds reopened.*
- *$1,288,288 worth of shellfish now available for harvest.*
- *Cost to state of $115,016.*
- *Additional shoreline cleanup projects under contract.*

[h]An additional $4,832 in agency funds were expended to cover personal expenses.

	1984-86 Funds	1986-88 Funds
● Reestablishment of submerged aquatic vegetation (SAV) by transplanting whole eelgrass plants or by reseeding; and studies into factors causing its success/failure. SAV provides habitat and food and acts as a nutrient buffer and sediment trap.	150,000[i]	150,000

RESULTS TO DATE
- *Experimental plots established at 21 locations.*
- *Varied rates of survival.*
- *Phenomenal growth (100-fold increase) in some areas.*
- *New efforts to focus on use of seeds.*

[i]Does not include VIMS support (non-Initiative Funds) of $190,679.

	1984-86 Funds	1986-88 Funds
● Establishment of a Fishery Management Division to improve and maintain critical finfish and shellfish stock including the development of methods to reduce fishing mortality, collection of catch statistics and biological data, and rebuilding and maintaining spawning stock.	240,780	293,100

RESULTS TO DATE
- *Management plans nearing completion for:*
  Striped Bass
  Oysters
- *Next to be developed include:*
  Shad
  River Herring
  Hard Clams

	1984-86 Funds	1986-88 Funds
● Placement and maintenance of artificial fishing reefs which provide increased habitat for recreational fishing.	259,739	264,361[j]

RESULTS TO DATE
- *40% increase in annual additions of reef material at three sites.*
  Parramore Reef–off Wachapreague Inlet
  Tower Reef–east of Ches. Bay Light Tower
  Triangle Reef–east of Cape Charles.

[j]Includes $8,961 carried forward from 1984-86.

	1984-86 Funds	1986-88 Funds
● Improvement of commercial public boat landing sites and planning for others requiring repair.	90,768	139,232[k]

RESULTS TO DATE
- *Repairs and site improvement completed at 12 public landings.*

[k]Includes $39,232 carried forward from 1984-86.

	1984-86 Funds	1986-88 Funds
● Removal of hydrilla from the Potomac River by U.S. Army Corps of Engineers. (New for 1986-88)	0	75,000

RESULTS TO DATE
- *50 acres of hydrilla cleared from around channels, access to marinas.*

	1984-86 Funds	1986-88 Funds
● Implement scientific methods for establishing marina condemnation buffer zones, assess boat holding tank chemicals on septic systems, and boater sanitation education. (New for 1986-88.)	0	150,000

RESULTS TO DATE
- *Work begun, proceeding on schedule.*

Education

	1984-86 Funds	1986-88 Funds
● Development of education programs for citizens on the importance of the Bay, its problems, and its solutions, in order to:		
• Produce public service announcements for TV and radio;	$ 40,000	$ 0[l]
• Provide Chesapeake Bay educational grants to schools and institutions;	250,000	250,000[k]
• Funds to support the production of a documentary film on the Bay to be broadcast on public television;	50,000	0[l]
• Establish youth employment projects—funds to hire teenagers to work on summer projects which reduce soil and sand erosion and nonpoint source pollution entering rivers and streams;	270,000	600,000
• Support on-the-water studies for school children—to help more children participate in the Chesapeake Bay Foundation's education program.	90,000	180,000

RESULTS TO DATE
- *Over 1600 information calls responded to.*
- *Permanent educational exhibits completed at*
  –Virginia Marine Science Museum, Virginia Beach
  –Science Museum of Virginia, Richmond
  –Science Museum of Western Virginia, Roanoke
- *Traveling computerized exhibit developed.*
- *Over 15,000 students given one-day program by visiting teacher.*
- *Over 2700 students participated in on-the-water field trips.*
- *Public television documentary completed and aired.*

[l]These projects have been completed.

Research

	1984-86 Funds	1986-88 Funds
● Support of research projects which will provide information necessary to better manage the Bay and its resources. They help assess the positive and negative impacts associated with applying new technologies for improving water quality, such as determining at what level nutrients become harmful to the quality of saltwater. The purpose of these studies is to:		
• Analyze biological and physical factors causing declining oyster and critical finfish populations;	$ 1,700,000[m]	$ 2,000,000
• Develop advanced techniques for detecting metabolized toxics in seafood;		
• Assess health effects of Kepone (pesticide) on humans.	300,000	300,000
• Predict movement of estuarine waters and material transport by a three dimensional model. (This is a new program for 1986-88).	0	525,000

RESULTS TO DATE
- *Three-dimensional circulation model acquired.*
- *Circulation identified as critical in success of James River seed oyster beds.*
- *Population prediction techniques under development for striped bass, other species.*
- *High performance liquid chromatography—mass spectrometry system (only one of its kind in marine science) developed by VIMS to analyze chemical pollutants.*
- *Kepone health effects results due in 1988.*

[m]Does not include VIMS support (non-Initiative Funds) of $39,103.

Support

	1984-86 Funds	1986-88 Funds
Provide management and support services for an automated data management system, in order to:		
• Develop a coordinated data base system linking state agencies, research institutions and the U. S. Environmental Protection Agency;	$ 300,000	$ 21,234
• Purchase a computer system for the Virginia Water Control Board to manage state regulatory information;	921,000	600,000
• Computerize fisheries mangement information;	166,850	93,000
• Manage and coordinate state Chesapeake Bay Initiatives at one central location and prepare periodic status reports;	75,000	111,299[11]
• Support the Chesapeake Bay Commission;	160,000	170,000
• Reimburse localities which operate their own marine patrols for law enforcement, safety, or rescue;	750,000	805,600
• Implement and administer the Virginia Water Control Board's Chesapeake Bay Initiatives (New for 1986-88)	0	254,398

RESULTS TO DATE

- *Initial computer hardware, software and linkages are now in place in state agencies.*
- *Detailed status reports on all initiatives have been published quarterly; progress reports published for 1985; and 1986.*
- *Other projects completed as indicated.*

[11]Includes $48,239 in federal grant funds to support staffing of the Governor's River Basin Citizens Committees.

Monitoring

	1984-86 Funds	1986-88 Funds
Development of monitoring programs designed to facilitate the collection and maintenance of information critical to Bay management, and to:		
• Monitor levels of Kepone (pesticide) in the James River;	$ 139,479	$ 151,480
• Monitor water quality in the James River to determine what reasonable waste loads can be discharged by STPs and industries without upsetting the assimilative characteristics of the river;	400,000	0[1]
• Monitor water quality and habitat resources on a frequent basis in the Bay's tributaries and in the mainstream; conduct nutrient studies of the major tributaries.	300,000	1,660,254[9]

RESULTS TO DATE

- *All monitoring projects continue on an on-going basis in conjunction with other state and federal agencies.*

[1]These projects have been completed.
[9]Includes EPA grants of $792,000.

TOTALS	**$14,937,604**	**$23,513,589**

In addition, two other new projects have been initiated in the 1986-88 biennium:	
• Water and sewage treatment facility grants for localities with a limited ability to pay;	400,000
• Establishment of the Virginia Water Facilities Revolving Fund for construction loan assistance. Both of these projects will be applied statewide; however, over half of the Commonwealth lies in the Chesapeake Bay drainage basin and treatment plans in this region receive top priority ranking.	20,000,000
	$43,913,589

Of the adjusted net appropriation of $17,157,451 for 1984–86 Initiatives, $14,937,604 was expended in 1984–86 and $2,219,847 was carried forward to 1986–88.

The implementation of these activities is taking place in a coordinated program designed to target the funds available where they will be most effective. Levels of water quality and habitat deterioration vary from one tributary river to another as do the sources of that deterioration. Virginia's approach has been to apply a particular mix of programs to each basin according to its specific characteristics.

Other Initiatives in the Bay Region: District of Columbia, Maryland, Pennsylvania, and the Environmental Protection Agency

The coordinated effort to reverse the decline of the Chesapeake Bay is a dramatic example of how governments and citizens can work together towards accomplishing a common goal. The following is a brief summary of some of the Chesapeake Bay Initiatives of the District of Columbia, Maryland, Pennsylvania, and the Environmental Protection Agency.

The District of Columbia lies adjacent to the Potomac River and straddles the Anacostia River, a tributary of the Potomac. Since the District is heavily urbanized, efforts are directed towards associated urban problems such as stormwater runoff, sewage overflow and erosion control. Some of the District's efforts include:

- Enacting a Comprehensive Water Quality Act addressing water quality standards, point source discharges, pretreatment of industrial waste, treatment plant construction, nonpoint source control and other related activities.
- Constructing facilities limiting the frequency and volume of sewage overflow through the combined Sewer Overflow Abatement Program.
- Exploring ways of limiting stormwater overflows and controlling urban runoff.
- Improving the regional Blue Plains Wastewater Treatment Plant including the construction of dechlorination facilities.
- Directing educational programs informing the public about how to maintain and preserve a clean water system.
- Developing Best Management Practices to help citizens living near the Anacostia River control erosion, handle pesticides and motor oil properly, and care for their yards in such a way that pollution to the river is reduced.
- Improving the Potomac's fisheries by identifying and describing types of fish in the area, developing regulations to protect fish in the Washington metropolitan waters, and negotiating with several jurisdictions to eliminate blockages in the Potomac that hinder fish movement.

Maryland bounds both sides of the Bay and has also developed a wide array of initiatives and programs designed to address Bay-related problems. Some of these efforts include:

- Controlling point source pollution through the construction and improvement of sewage treatment plants, bringing existing plants into compliance with state and federal regulations, enforcing pretreatment programs requiring industries to reduce waste content in effluent they send to publicly-owned treatment plants, and providing grants for installing dechlorination equipment at publicly-owned treatment plants.
- Addressing nonpoint pollution through Best Management Practice (BMP) activities such as demonstration projects, technical assistance, education programs, cost-sharing to farmers for implementing BMPs, providing construction funds for shoreline erosion control, and initiating a program of urban stormwater demonstration grants.
- Restoring fisheries, wildlife, and habitat resources through research; developing fisheries management plans for important Bay species; replenishment of shellfish growing areas by transplanting oyster shell; operating fisheries, black duck and oyster hatcheries; restoring black duck habitat and planting submerged aquatic vegetation.
- Supporting education efforts including field trips and studies, distribution of Bay-related materials, and grants for Bay-related projects.
- Establishing a Critical Area Commission to guide local land use along the shore of the Bay and its major tributaries.
- Carrying out a variety of monitoring and research projects and activities on water quality, habitat and others.

Pennsylvania is focusing its Bay cleanup efforts on the reduction of nutrients from agricultural sources in the Susquehanna River's drainage basin. The Susquehanna River is the largest river in the Bay basin, contributing nearly 50% of the Bay's freshwater. Some of the major thrusts of the Pennsylvania program include:

- Promoting an aggressive Best Management Practices program through technical and financial assistance, demonstration projects, monitoring, farmer-to-farmer meetings, educational activities, and providing experienced field staff to assist farmers in reducing erosion and nutrient loss.
- Enhancing certain fishery resources of the Susquehanna River through activities such as stocking, hatching, transporting fish upstream, regulating fishing practices, and planning for ways for fish to migrate around dams.
- Regulating wetland development.
- Promoting a strong educational program through meetings, media, and the schools.
- Targeting for pretreatment programs those sources of industrial waste which are being discharged into publicly-owned sewage treatment plants.
- Controlling phosphorus at municipal and industrial treatment plants within the Susquehanna River Basin, especially the lower basin.

The Environmental Protection Agency functions as a central liaison for Chesapeake Bay Agreement governmental activities. Federal entities provide funding support, research support, and manpower for the Bay program. Other federal participants include the U.S. Fish and Wildlife Service, National Oceanic and Atmospheric Administration, the U.S. Army Corps of Engineers, the Soil Conservation Service, Department of Defense, and the U.S. Geological Survey. Some of the specific federal activities include:

- Providing EPA grants for the support of a variety of state nonpoint source pollution control projects. (In Virginia alone EPA provided $3,050,004 for nonpoint activities for the 1984-86 biennium. This support is projected to be $4,162,950 for the 1986-88 biennium.)
- Supporting monitoring and research activities in the Bay through funding and participation of federal agency personnel and scientists.
- Maintaining and operating the Chesapeake Bay Program Computer Center at Annapolis, Maryland.

These activities of the Bay-area states, District of Columbia, and Environmental Protection Agency emphasize wide-ranging project efforts of the Chesapeake Bay basin necessary for a successful cooperative and regional program.

Description

The Potomac River watershed includes parts of northern Virginia, Maryland, West Virginia, and all of the District of Columbia. The Potomac River itself lies completely within the State of Maryland, and except for embayments, the river's fisheries are governed by the Potomac River Fisheries Commission.

With a drainage of 14,669 square miles, the Potomac is second only to the Susquehanna River in size and volume of flow among Chesapeake Bay tributaries. It contains the largest urban concentration within the Bay system, the Washington metropolitan area, as well as the largest single municipal sewage treatment plant (Washington's Blue Plains plant). Virginia's portion of the basin accounts for 42% of the land area (5,747 square miles) and a population of 1.4 million, projected to rise to 1.9 million or a 35% increase, by the year 2000.

Approximately 7,600 acres of productive shellfish grounds are closed to harvest. Some of these closings are due to sewage treatment plant outfall, others are due to contamination from runoff.

In spite of some improvements in the water quality, oyster harvests and reproductive success have declined, and landings of anadromous finfish have also declined. Some of the finfish decline may be attributed to loss of access to spawning grounds due to dams and other impediments. Blue crab harvests have remained comparatively stable.

Nutrient Loadings

While the Virginia portion of the Potomac basin is largely rural, (only about 7% is urban), nutrient problems are about equally attributable to both point and nonpoint sources. The Shenandoah River basin, the Potomac's major tributary in Virginia, and the lower Potomac River basin, contribute runoff from agricultural lands including crop and livestock operations. Nonpoint source loads vary from year to year as a result of rainfall runoff, dependent upon the length and frequency of storm events.

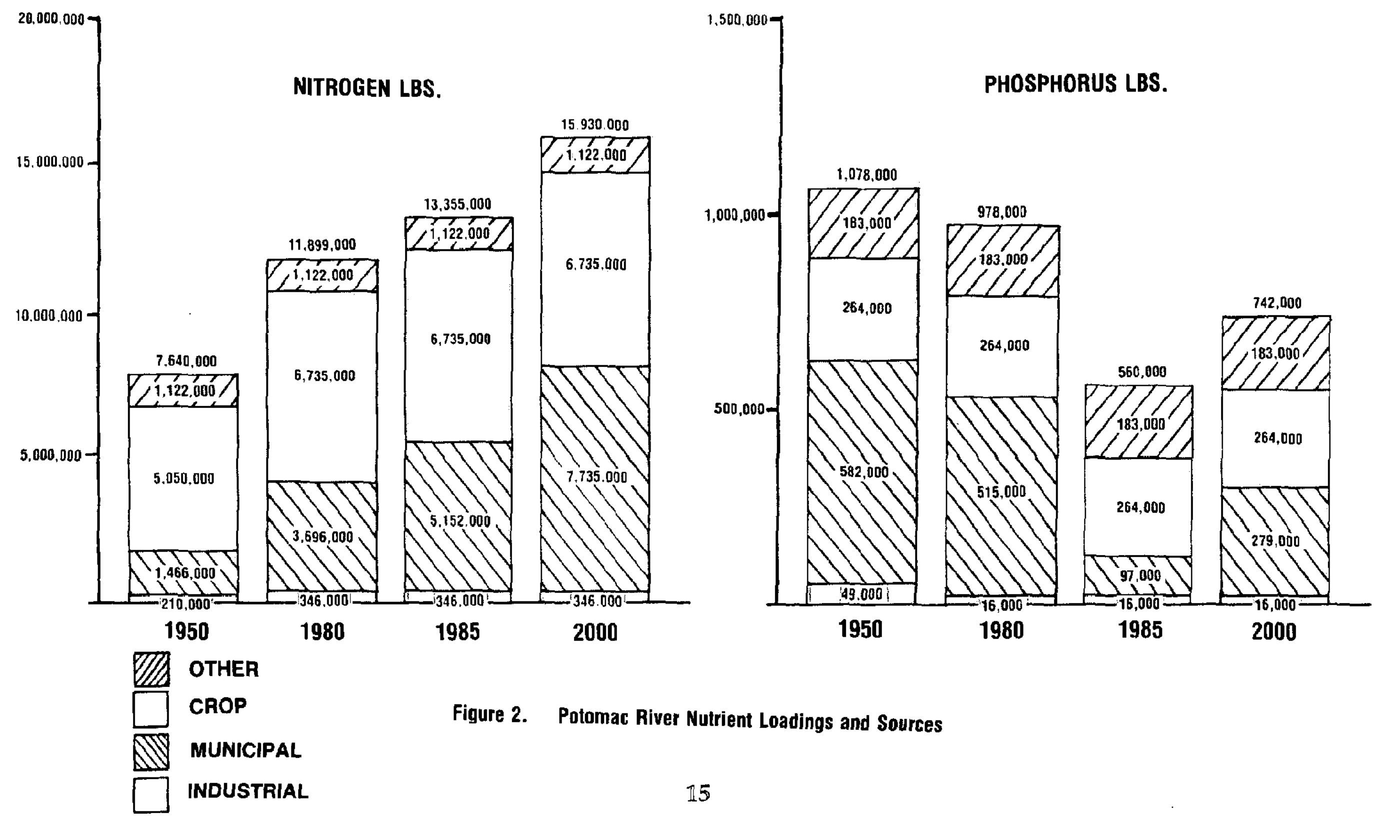


Figure 2. Potomac River Nutrient Loadings and Sources

The point source contributions are primarily from the river embayments in the upper estuary of the river in Northern Virginia. Although the municipal sewage treatment plant (STP) dischargers began removing phosphorus during the 1970's (see Figure 3) and waste loadings have greatly decreased, some nutrient problems still occurred in this area of the river. Due to the physical characteristics of the embayments, such as limited flushing capabilities, as well as nutrients harbored in sediments, algal blooms can still occur even though the STPs are employing the best available technology for phosphorus removal. And as population increases in the areas, nutrient loads to the river will increase as well because STP flows will increase. The future nutrient reduction potential, therefore, lies in nonpoint source reductions in both the Shenandoah and Potomac Rivers. Long-term monitoring will help our understanding of the linkage between trends in nutrient reduction, and water quality from both point and nonpoint sources.

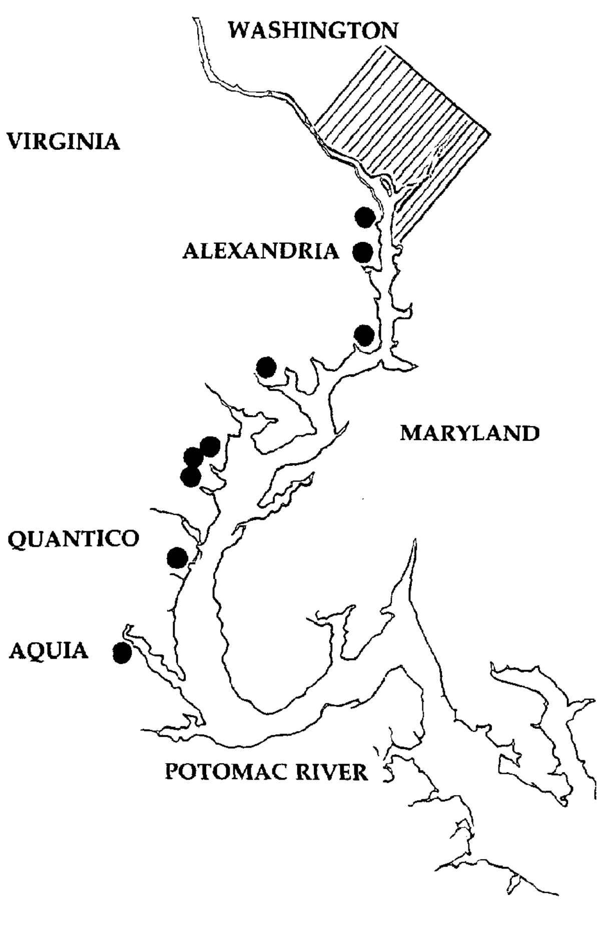


Figure 3. Municipal STPs Employing Nutrient Removal

Water Quality

Potomac River water quality is monitored by the State of Maryland since the river lies entirely within their boundaries. The data presented in Figure 4 compare the 1984 condition of the river to the 1985 condition. An analysis of these data follows.

The main parameters used to measure water quality are defined below. These parameters will be used for each of the rivers and the Bay mainstem as a measure of progress in the improvement of water quality.

1. **Dissolved oxygen** is an important indicator of water quality as it shows the amount of oxygen available for aquatic organisms.
2. **Total phosphorus and total nitrogen** indicate available nutrient concentrations which, when present in large amounts, can result in excessive algal growth and in severe cases, algal blooms. Excessive algal growth reduces the amount of dissolved oxygen in the water when the algae die off and decompose creating aesthetic problems and reducing the light needed by submerged aquatic vegetation.
3. **Chlorophyll-a** is a green pigment found in algae. Measurements of chlorophyll-a indicate the amount of algae present in the water column.
4. **Secchi depth** is a measurement of water clarity, which is dependent on the concentration of algae and suspended solids in the water column.

Water Quality Conditions

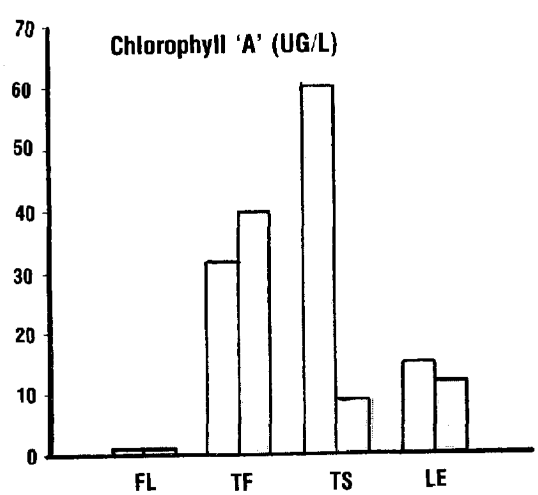
Potomac River water quality is primarily affected by heavy agriculture above the fall line and urban development with municipal sewage treatment plant discharges in the tidal fresh zone.

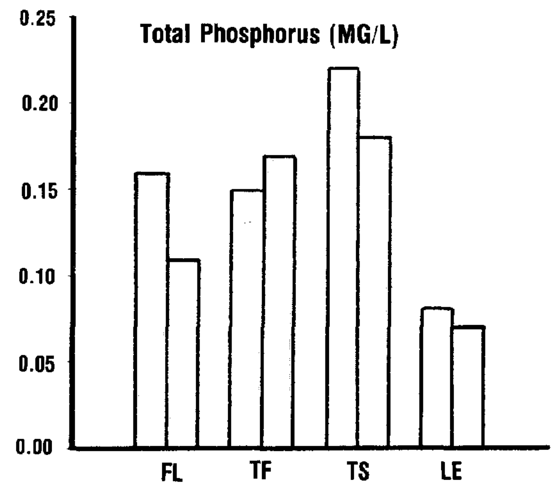
Nitrogen levels at the fall line and tidal fresh zones are much higher than those of the Rappahannock, York, and James Rivers. The fall line and tidal freshwater zone concentrations of phosphorus are comparable to the concentrations in the James River but the transition zone exhibits much higher concentrations than any other Virginia river. This area also corresponds to the areas that have experienced the worst algal blooms of 1984 and 1985. Both phosphorus and nitrogen decrease rapidly in the lower estuary zone to levels very close to those of the other rivers.

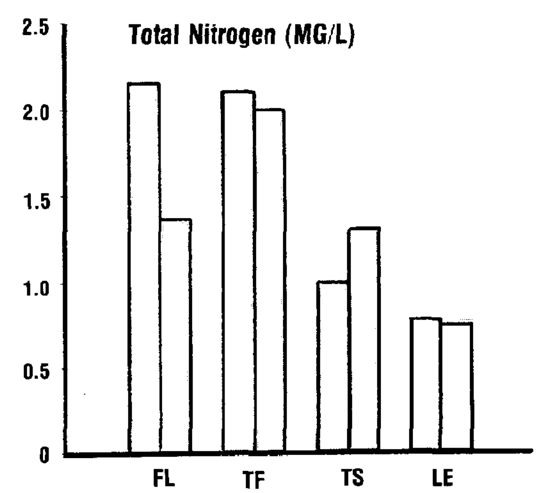
The unusually high levels of algal production in the Potomac River greatly exceeds the levels found in the other rivers. This undesirable overproduction of algae has prompted the policy of phosphorus removal for municipal dischargers in an effort to control these blooms. The very wet summer of 1984 produced bloom conditions of 50-100 ug/l (micrograms per liter) for chlorophyll and pushed the peak of the bloom further downstream than normal. The tidal freshwater zone averaged 30-40 ug/l while the transition zone experienced an untypically high average of 55 ug/l. The summer of 1985 produced chlorophyll levels of 40 ug/l in the tidal freshwater zone and more typically experiences levels near 10 ug/l. However, during the spring of 1985 there was a blue-green bloom of 90 ug/l.

The upper Potomac River experiences short-term oxygen depletion in certain areas. The embayments often experienced supersaturation of dissolved oxygen due to very high algal production rates. The lower Potomac behaves very much like the main Chesapeake Bay with stratification and very low dissolved oxygen during the summer months.

No cause and effect relationships can be drawn between pollution abatement measures and water quality this early in the Bay cleanup effort. Conditions are reported here so that trends can be established.







SEASON
Summer '84 ☐ Summer '85 ☐

Figure 4. Potomac River Water Quality

Strategies

Among Bay tributaries, the Potomac River may offer the best illustration of what we hope to accomplish throughout the Bay. Characterized by severe nutrient problems in the 1960s, the addition of nutrient removal capabilities at sewage treatment plants (STPs) in all Washington area jurisdictions and Virginia embayments has led to dramatic improvements in water quality. Water quality models have been developed and are currently being used to determine what future point source controls will be necessary. Also, in the Potomac River embayments (Virginia jurisdiction) point source pollution is being reduced at some STPs through chlorine reduction. Since the phosphorus loading from STPs has already been significantly reduced in the Potomac River, future attention to nonpoint sources from both urban and rural areas should result in even further improvement.

In the headwaters of the Potomac River, and particularly in the Shenandoah River sub-basin, Virginia's Chesapeake Bay Initiatives are aimed primarily at reducing nonpoint source pollution. They focus on encouraging farmers through cost-share grants and education to adopt Best Management Practices (BMPs). Some effort has also been initiated to demonstrate to developers and local governments the merits of urban BMPs.

Nonpoint Source Pollution Control

Agricultural Best Management Practices

A heavy concentration of livestock in the Shenandoah River basin creates a high potential for nutrient loading to the Potomac River. Runoff from manure containment areas and feed lots often result in water quality problems. Under a Chesapeake Bay Initiative, 27 new animal waste systems at livestock operations have been installed in the Shenandoah Valley during FY 1985-86. As a result of this cost-share program, 53,766 tons of animal waste are now being controlled annually to reduce their potential for water pollution. The state paid $323,489, or 37% of the cost of these projects. A federal cost-share program contributed an additional 16%; the farmer paid the remaining 47%.

The cost of an animal waste control facility ranges from $10,000 to $150,000 depending on its design and number of animals served. This cost can be shared by the state, the farmer, and some federal assistance is available. During the first biennium of the Initiatives' program, only livestock farms in the Valley were eligible. But because these waste control facilities have been shown to have a direct effect on reducing nonpoint nutrient pollution, farms located elsewhere in the Bay basin of Virginia are now eligible to participate in this cost-share program.

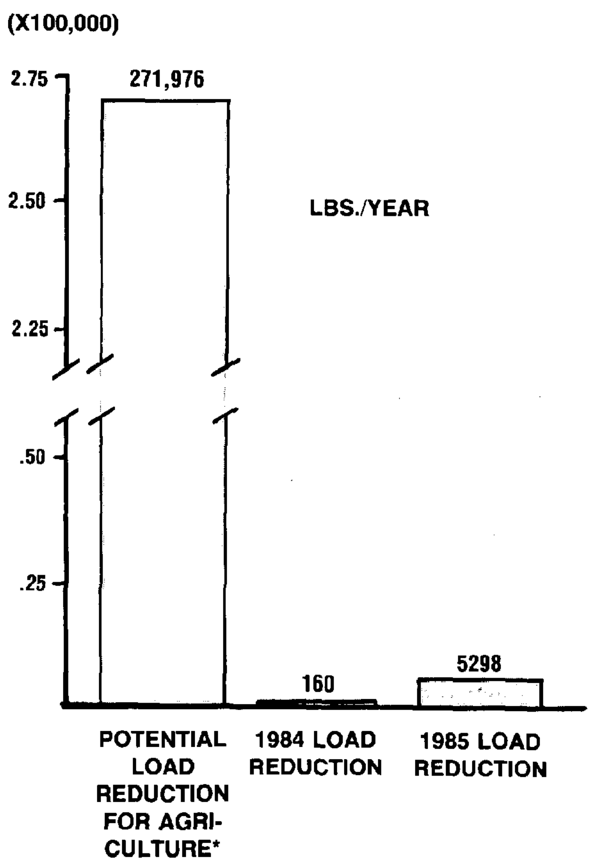
A no-discharge lagoon is often part of an animal waste control facility.

To measure the effectiveness of pastureland BMPs and animal waste control, an extensive surface and groundwater monitoring project has been developed by the Division of Soil and Water Conservation. Located near Calverton in Fauquier County, the Owl Run watershed was selected for demonstration because it is a livestock-dominated area. A BMP watershed plan is being developed for the implementation and monitoring of waste storage facilities and nutrient controls.

Farming practices that reduce soil erosion and fertilizer runoff from crop and pastureland are also important in the Potomac River basin for nutrient control since many of the point sources on the river are already addressing nutrients. As a result of the cropland BMP cost-share program for calendar years 1984 and 1985, 11,520 acres have benefited in the Potomac River basin by 304 farmers. The State share of these costs was $189,992, or 57%. For the 1986 program, 40 farmers, out of 382 who signed up in the spring, have already installed their BMPs to benefit 1,115 acres. Soil erosion in 1986 is being reduced by an additional 7,900 tons per year, attached phosphorus by 5,031 lbs., and 2400 tons of animal waste are being handled. Figure 5 illustrates the results of farmer participation since the Chesapeake Bay Initiatives program began.

To assist farmers in implementing BMPs and to help administer the cost-share program in the Virginia Soil and Water Conservation Districts, employees were supported, in part, by this nonpoint source pollution control initiative in the 1984-86 biennium. A similar number will be supported in the 1986-88 biennium.

The Potomac River basin also has a large amount of pastureland, particularly in the Shenandoah River sub-basin where cattle and sheep concentrations are high. Pastures that are over-grazed and poorly managed tend to erode faster, resulting in higher pollution potential. The Division of

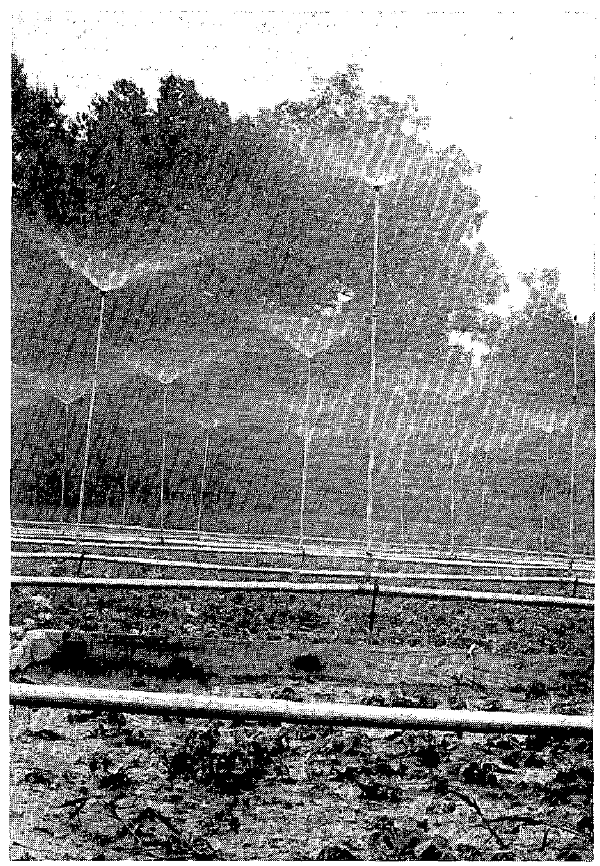


*Based on 1980 EPA average year agricultural load minus base loads.

Figure 5. Reduced Phosphorus Loading to the Potomac River as a Result of Cost-Shared Cropland BMPs

Soil and Water Conservation, in conjunction with the Agricultural Extension Service, has developed an education program to inform farmers about pasture management as well as other techniques to illustrate methods which reduce soil and fertilizer runoff.

Research and demonstration programs serve an important purpose in the education process. For example, a large modified irrigation system was set up in Augusta County over two pastures approximately one and a half acres in size: one plot was poorly managed, the other well managed. Rainfall was then simulated by the irrigation system and runoff collected in order to demonstrate the effectiveness of good pasture management. A significant difference in the quantity and quality of runoff between the two plots was immediately apparent. Rainwater ran off the well-managed pasture much later than off the poorly managed plot due to the increase in infiltration or ability for saturation. When runoff did begin, it was visually evident that the water off the well-managed plot contained less sediment than the runoff from the poorly managed plot.



Good cropland and pasture management practices are demonstrated under simulated cloudburst conditions.

To help determine the results of the state education efforts, National Conservation Tillage Information statistics are monitored. Table 2 illustrates a growing trend in no-till practices.

Year	No-Till Acreage	Other Conservation Till Acreage	Conventional Till Acreage	Total Acres Planted
1983	103,969 (31%)	112,577 (34%)	117,148 (35%)	333,694
1984	140,742 (37%)	105,661 (28%)	135,668 (35%)	382,071
1985	161,812 (41%)	110,811 (28%)	123,317 (31%)	395,941

Table 2. Potomac River Cropland Tillage.

An intensive ten-year water quality monitoring project has begun in a small watershed off the Nomini Creek in the Potomac River basin. The five square-mile watershed, characterized primarily by cropland farming, was chosen to specifically monitor the effects of BMP installation. Although initial results from the first year of monitoring have not been analyzed, trends will be established as more and more BMPs are installed in the watershed. Both surface and ground water are being analyzed for nutrient and chemical pollution.

Urban Runoff Controls

Urban development, established or under construction, takes its toll on the water quality of receiving rivers by contributing sediment, nutrients, and toxics. Rainwater carries these pollutants from streets, lawns, and roof tops. Several areas in the Potomac River basin were chosen to demonstrate to localities and developers the merits of urban Best Management Practices. The cost of installing and monitoring the effectiveness of the BMPs was shared by the state and participating locality. A stormwater management model was developed and will be tested in Fairfax County. Also, in western Fairfax County, a detention basin is being monitored with each storm to measure pollutant removal efficiency. And in central Fairfax County, a streambank will be stabilized using state-of-the-art techniques and vegetation.

To demonstrate the effectiveness of porous asphalt installed at the Davis Ford Park of Prince William County, rainfall was simulated at the location using a modified irrigation system similar to that used to demonstrate agricultural BMPs.

Several point sources control measures which will affect all the waters of the state are being evaluated or instituted. See *New Water Quality Standards* in the *Bay-wide and Coastal Issues* section for details on nutrient control and chlorine standards.

Point Source Pollution Control

Municipal Sewage Treatment Plants

In the Virginia portion of the Potomac River basin there are 20 significant municipal dischargers, that is, sewage treatment plants discharging more than one million gallons per day (mgd) located anywhere in the drainage basin or less than one mgd located below the fall line. Figure 6 illustrates the locations of those plants and designates those which have yet, but are scheduled, to meet final effluent limits as required by the Clean Water Act National Municipal Policy by July 1988.

Deterioration and breakage of sewerlines is common to all sewerage systems over time. One of the State's Chesapeake Bay Initiatives addresses this program by making available to localities cost-share grants for corrections. Grant recipients are chosen based on criteria including proximity to critical living resource habitats and spawning areas. See Figure 6 for locations of sites participating in the program.

Several localities are making improvements to their sewage treatment plants (STPs) with assistance from a state facility bonding authority. Created in 1984 as a Chesapeake Bay Initiative, the Virginia Resources Authority helps localities secure financing at interest rates below market. The Town of Colonial Beach is replacing its sewer system to reduce excess flow entering from rainwater during heavy storms; the Prince William Service Authority is refinancing existing and outstanding bonds, and the Upper Occoquan Sewage Authority is expanding the capacity of their STP which serves four local jurisdictions.

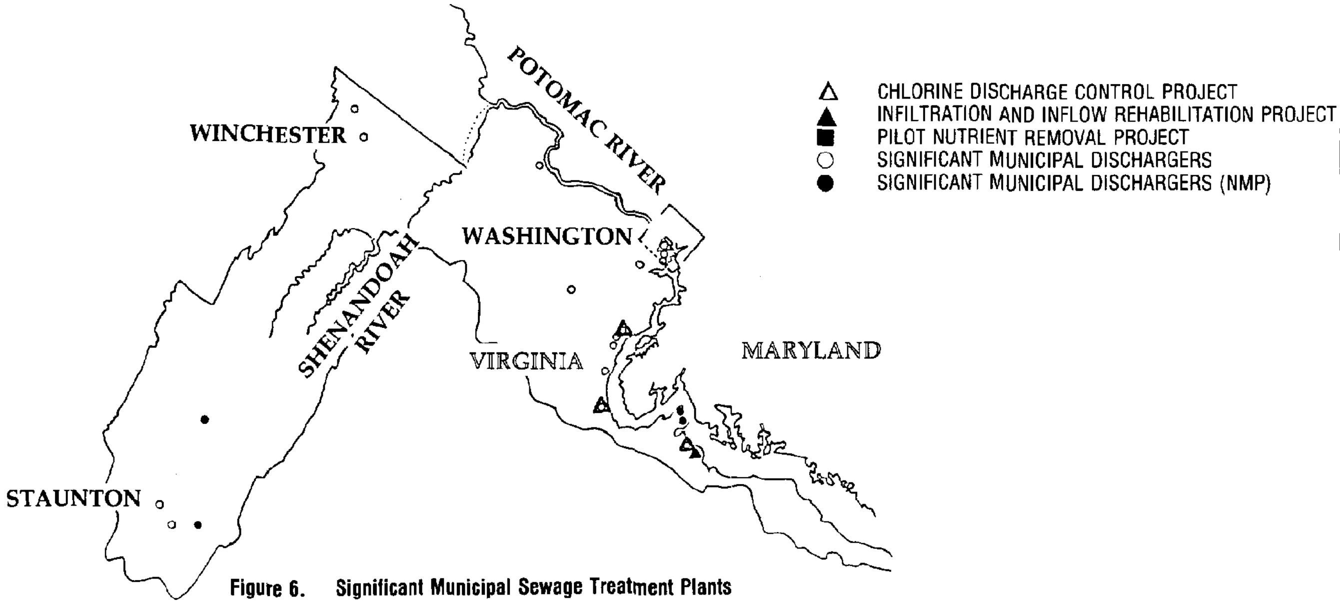


Figure 6. Significant Municipal Sewage Treatment Plants

Toxics Reduction, Monitoring, and Pretreatment Programs

Eight localities in the Potomac River basin are undertaking measures to reduce the level of chlorine discharged in their STPs' effluents. Survival of shellfish larvae, as well as the ability of finfish to reproduce, is affected by chlorine residuals.

A Chesapeake Bay Initiative provided $425,701 in grant assistance to three localities during the 1984-86 biennium (Stafford Co., Prince William Co., and Colonial Beach) and $427,725 at the start of the 1986-88 biennium (to Alexandria) for chlorine discharge control systems. These funds cover 75% of the cost for conventional dechlorination, (85% for alternative disinfection); the localities provide the remainder. Other STPs are reducing chlorine on a voluntary basis while still maintaining adequate disinfection to protect public health. All point source dischargers are now subject to the recently adopted water quality standards for chlorine, and may have to provide chlorine discharge control as a result. (See *Chlorine Standard* in the *Bay-wide and Coastal Issues* section of this report.)

As a result of the above methods, the 1984-86 total chlorine discharged into the Potomac River has been reduced by 750 lbs.—from 2400 lbs./day to 1650 lbs./day—a 31% reduction. In addition, 675 lbs./day will be eliminated as a result of the Initiative program continuing in 1986-88, bringing the total reduction in chlorine discharged to the Potomac River by Virginia to 59%.

Figure 7 shows the locations of STPs receiving State grants for chlorine reduction.

In the Potomac River basin the Virginia Water Control Board has issued discharge permits requiring toxics monitoring to twelve industrial or municipal treatment plants. An additional five toxics monitoring programs are under development. Seven municipal plants have approved pretreatment programs and another is in the final stages of development.

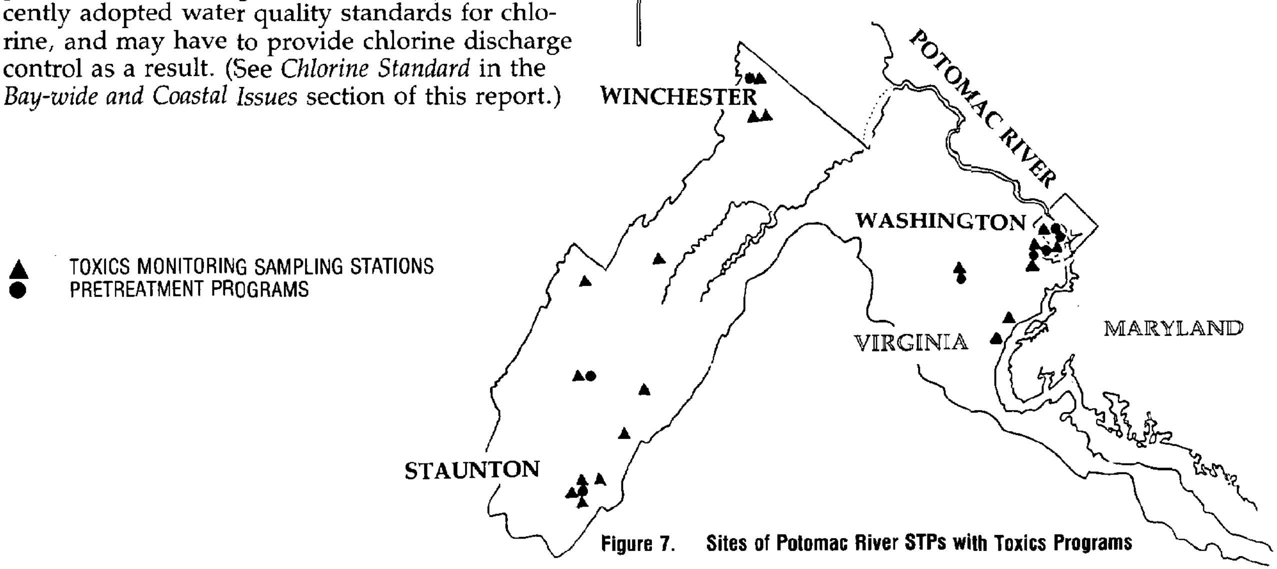


Figure 7. Sites of Potomac River STPs with Toxics Programs

Resources and Habitat Improvement

Shellfish Enhancement

Shellfishing in the Virginia Potomac River embayments is regulated by the Virginia Marine Resources Commission. (In the Maryland embayments, shellfishing is regulated by the Maryland Department of Health and Mental Hygiene.) Through the State's Chesapeake Bay cleanup efforts, deficient residential sanitation systems are being corrected. During the 1984-86 biennium, 127 acres of productive shellfish grounds and 60 acres of less-productive grounds in the Potomac embayments of Virginia were reopened to harvest, resulting in the availability of $57,200 in marketable shellfish. The reopened areas are located in Westmoreland County: Buckner Creek, Lower Machodoc Creek, and Jackson Creek.

Two other areas have also received attention in an effort to improve water quality through shoreline corrections so that shellfishing can again be permitted: Upper Nomini Creek and Mattox Creek. Farming is prevalent in the Nomini watershed—and animal pollution sources are much more difficult to pinpoint and abate than a faulty septic system. Water quality improvements of these latter two areas has not been successful thus far.

In some cases all known point sources of pollution are abated, yet fecal coliform counts remain high so that an area cannot be opened for the harvest of shellfish. Bonum Creek is such an example. Using federal grant funds from the National Oceanic and Atmospheric Administration (NOAA), a study of this area will begin in 1987 in an attempt to identify nonpoint sources of pollution and seek measures to correct them.

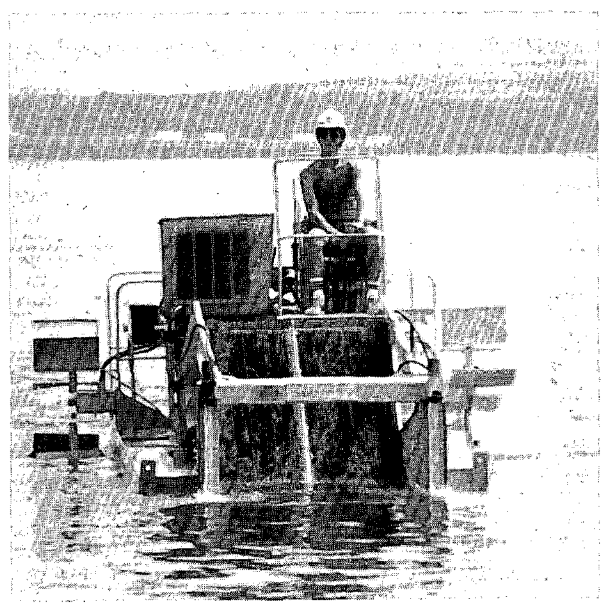
Submerged Aquatic Vegetation Reestablishment Program

Experimental transplanting of eelgrass, the most common of the submerged aquatic vegetation (SAV) types found in Virginia waters, was conducted by the Virginia Institute of Marine Science in the fall of 1984 in the Potomac River. Two acres were planted near the mouth of the Coan River, half of the plants being fertilized. Although soon after transplanting fertilized plants showed more leaf matter and mass, ultimate plant survival was not dependent upon such fertilization. Five months after planting 72% survived, but after seven months only an average of 41% remained; one year later no plants were found living. Factors causing the failure of SAV to reestablish are discussed in the York River basin section. But because no success was had at this site in the Potomac River, it was not included in second year transplant efforts.

Hydrilla Control

Hydrilla verticillata is a type of non-native submerged aquatic vegetation accidentally introduced to the Potomac River in the early 1980s. Like other SAV, hydrilla provides sediment control and oxygen and habitat critically needed by fish and crabs. At the same time, however, hydrilla outcompetes native species and grows in thick mats creating problems for boaters and marinas. State scientists are evaluating the benefits and detriments of allowing the establishment of hydrilla as a desirable SAV in Virginia waters.

During July 1986 the U.S. Army Corps of Engineers began mechanically harvesting hydrilla in order to keep access areas to the shore of the Potomac River open for boating and other public uses. The Commonwealth of Virginia is contributing $75,000 in the 1986-88 biennium to assist in this effort. About 50 acres of plants were harvested initially primarily along the Virginia shoreline south of Washington, D.C.



Hydrilla was mechanically harvested in the Potomac River during Summer 1986.

Photo credit: Curtis Dalpra/ICPRB

Rappahannock River Basin

Description

The Rappahannock River basin drains 2,631 square miles of north-central Virginia. It is almost entirely rural and heavily forested, with Fredericksburg the only major city. The 1980 basin population was 150,000 and is projected to increase to 209,000 or 39% by the year 2000. It is the least polluted of the Bay's major tributaries. Due to increasing pressure to urbanize the drainage basin, however, the potential exists for deterioration of surface water quality in the near future.

Declining trends in resource availability have already become apparent. Commercial oyster harvests have dropped as well as the oyster reproductive potential. There are currently 7,611 acres of productive shellfish beds closed to harvest due to fecal coliform contamination from deficient residential sanitation facilities, sewage treatment plants, marinas, or unsatisfactory water quality. Submerged aquatic grasses had disappeared from the river by 1975.

Nutrient Loadings

The majority of 1985 nutrient loadings in the Rappahannock River basin, (85% of nitrogen; 59% of phosphorus) comes from nonpoint sources—forestry, agriculture, and urban runoff. The remainder comes from municipal and industrial point source discharges.

If no additional nutrient initiatives or control strategies are implemented, phosphorus loads are expected to increase by 44%, and nitrogen 15%, by the year 2000. Figure 8 illustrates nutrient loadings to the Rappahannock River—past, present, and future.

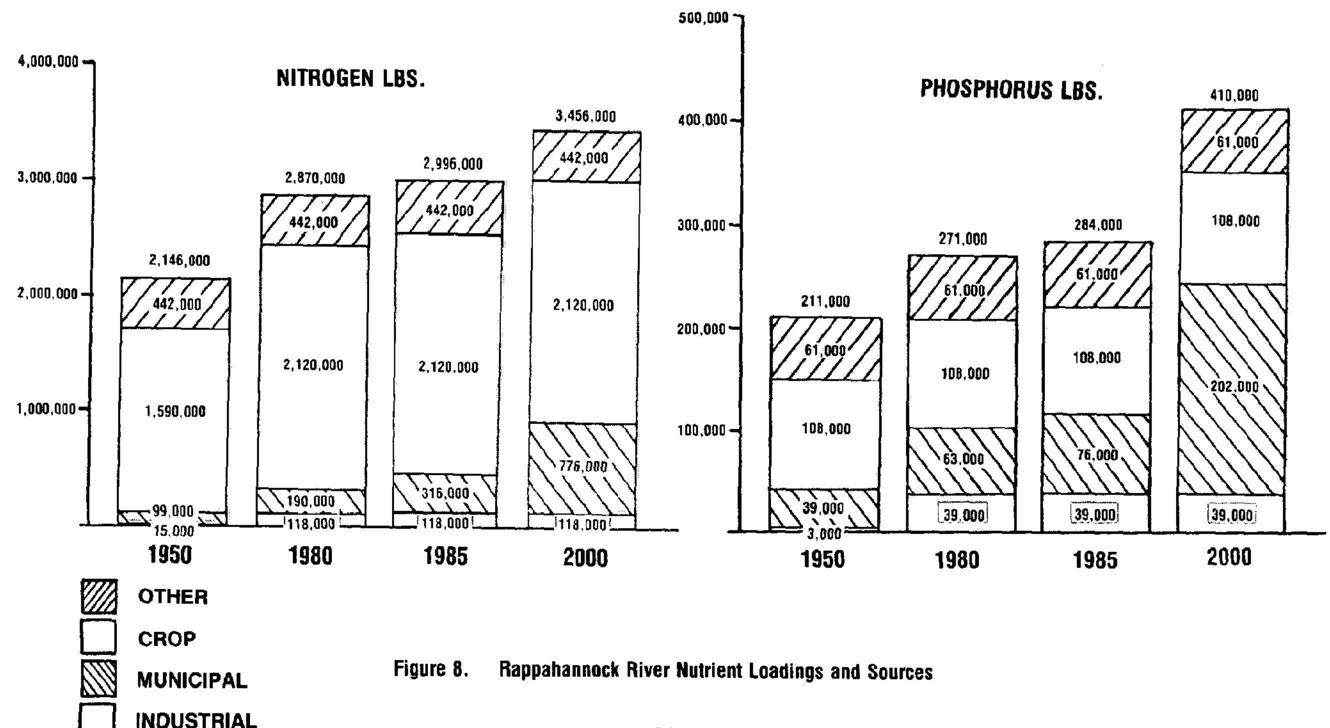


Figure 8. Rappahannock River Nutrient Loadings and Sources

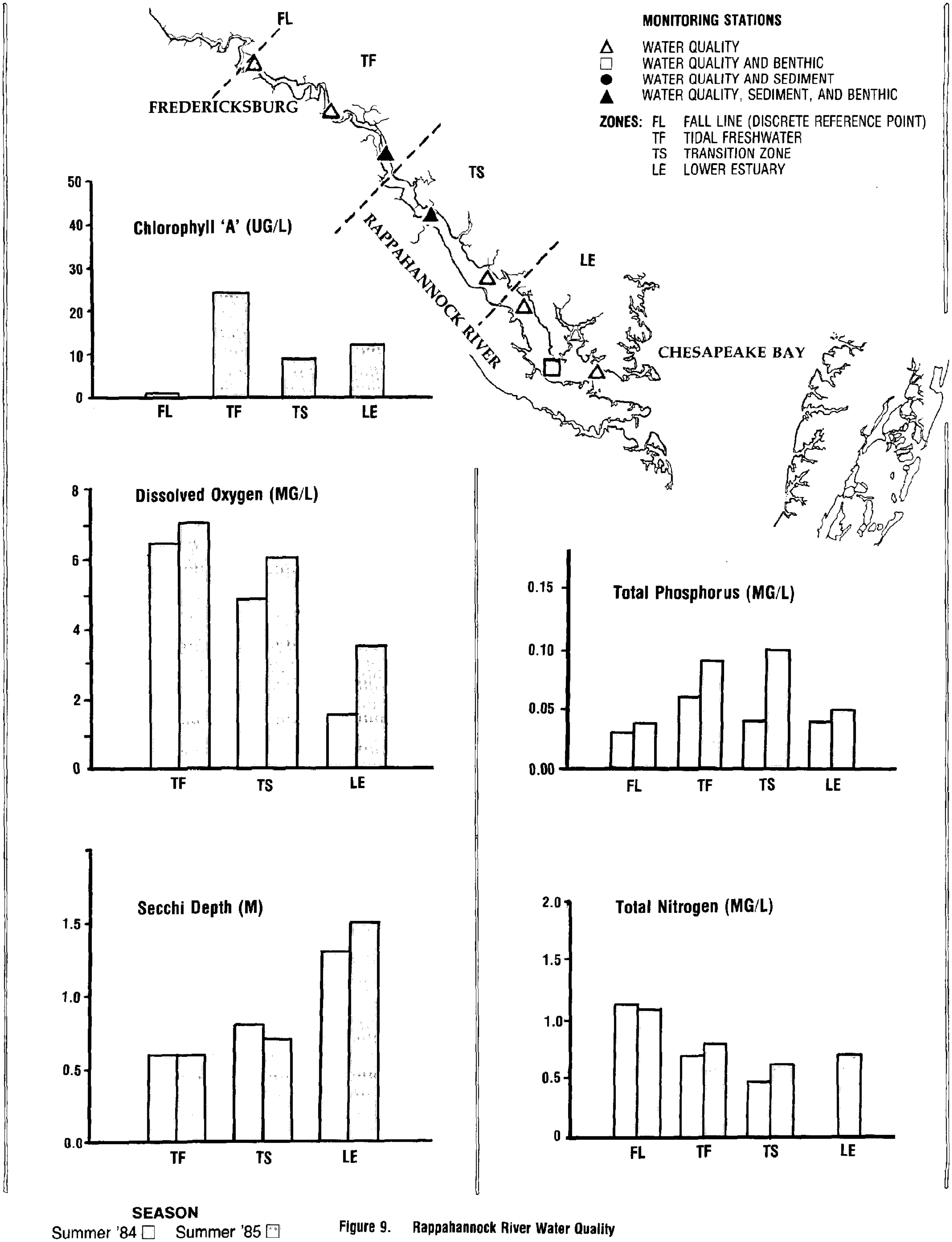


Figure 9. Rappahannock River Water Quality

Water Quality

With the exception of the Potomac River, the Virginia Water Control Board (VWCB) monitors water quality in the major Bay tributaries in Virginia, and contracts with the Virginia Institute of Marine Science and Old Dominion University to monitor the mainstem of the Bay. Since 1984 water samples have been collected twice per month from March through October, and once per month from November through February in three sections of the river: tidal fresh (TF), transition (TS), and lower estuary (LE). The fall line stations are sampled once per month.

Figure 9 compares baseline 1984 sample data to 1985 conditions. Sampling locations are indicated on the adjacent map.

Water Quality Conditions

The Rappahannock River basin contains a large amount of agricultural area above the fall line and some urbanization around the fall line but the lower river is basically unaffected by development. Total nitrogen concentrations at the fall line are relatively high but quickly decrease and level off downstream. In contrast to the high nitrogen levels at the fall line, phosphorus concentrations are very low. The phosphorus levels tend to increase in the tidal fresh and transitional zones of the river due to some point source inputs and the natural occurrence of the turbidity maximum zone where nutrients and sediment naturally accumulate. During the summer of 1985, there was a sharp increase in phosphorus concentrations. Chlorophyll-a levels averaged around 25 ug/l (micrograms per liter) in the tidal freshwater zone but dropped rapidly to average near or below 10 ug/l for the rest of the river.

The lower Rappahannock River often experiences summer stratification similar to the Bay itself. Lighter freshwater flows over the denser saltwater in the deep channel at the river mouth. This layering prevents mixing of the top and bottom waters and often results in low oxygen in the deep waters of the main channel. During the summer of 1984 the high freshwater flows intensified this layering and resulted in low dissolved oxygen concentrations in the lower estuarine and transition zones. During the worst point of the 1984 summer, up to 32 miles of the river experienced dissolved oxygen below 2 mg/l. During the dry summer of 1985 the layering was not as strong and dissolved oxygen depletion was not as severe because tidal and storm forces periodically caused the mixing of the two layers.

Strategies

The Rappahannock River is a high priority area for the State's agricultural Best Management Practices (BMP) program. A geographical information data base identifying all potential pollution sources has been created for the entire basin and this information will be first used on a pilot basis in the 1987 BMP program for targeting cost-share and educational efforts. Primarily for BMPs which manage cropland runoff, the State is encouraging the use of stripcropping, no-till farming, and the installation of vegetated filter strips among others.

Several of the Chesapeake Bay Initiatives aimed at reducing point source pollution are also targeted in the Rappahannock River basin. These include reducing chlorine and nutrients discharged by sewage treatment plants.

The Rappahannock River and many of its tributaries are well suited for productive recreational and commercial fisheries. Efforts to reduce residential sanitation system violations along the shoreline are concentrated here so that shellfish grounds may be reopened. In addition, seed oysters and oyster shell have been transplanted in order to replenish many of the once-productive oysters rocks located there. Food and habitat areas for crabs and finfish are being improved through the submerged aquatic vegetation replanting program.

Nonpoint Source Pollution Control

Agricultural Best Management Practices

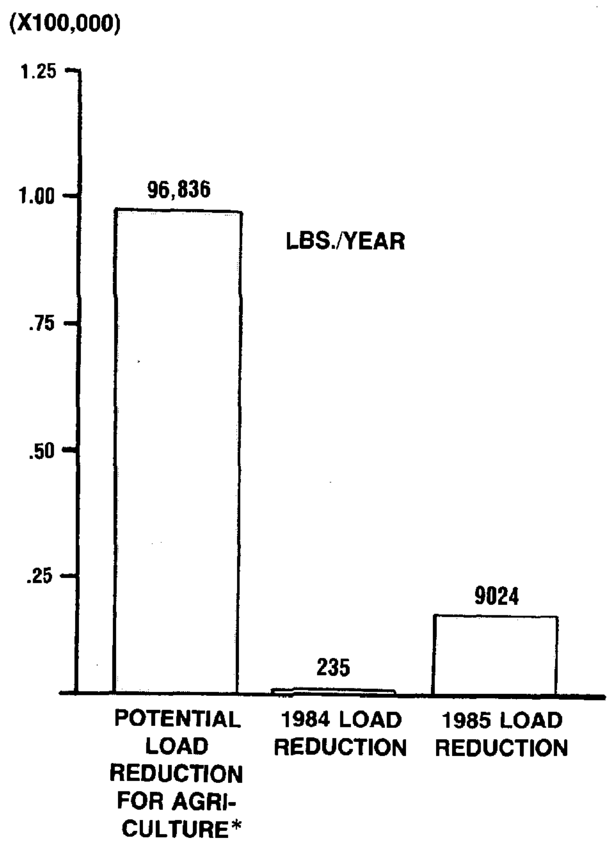
An analysis of the 1983 EPA Chesapeake Bay Study report findings indicated a potential for improving water quality in the Rappahannock River basin through cropland pollution control efforts. The State's Agricultural BMP program particularly targets cropland conservation measures for this watershed. In the first two calendar years of the program implementation (Fall 1984 and all of 1985), 14,174 acres of farmland benefited from conservation practices cost-shared by the State. The amount of phosphorus entering the Bay has thus been reduced by almost 9,300 lbs. per year and soil escaping farms by 100,150 tons per year. The State paid $215,595, or 70% of the total projects' cost involving 381 farmers. For the 1986 program, 67 more farmers have implemented practices to date of the 265 who signed up at the beginning of the calendar year. The others have until the year-end to install their practices. Figure 10 illustrates some of the results of farmer participation.

To assist farmers in implementing BMPs and to help administer the cost-share program in the Soil and Water Conservation Districts, employees are being supported in part by the agricultural nonpoint pollution control initiative.

Other farmers are using conservation tillage and are not necessarily participating in the cost-share program. Many of these are employing the practices as a result of the State's educational efforts. Since 1984, the number of acres being conservation-tilled is estimated to have decreased by 6%. However, the amount of acreage under no-till increased 11%.

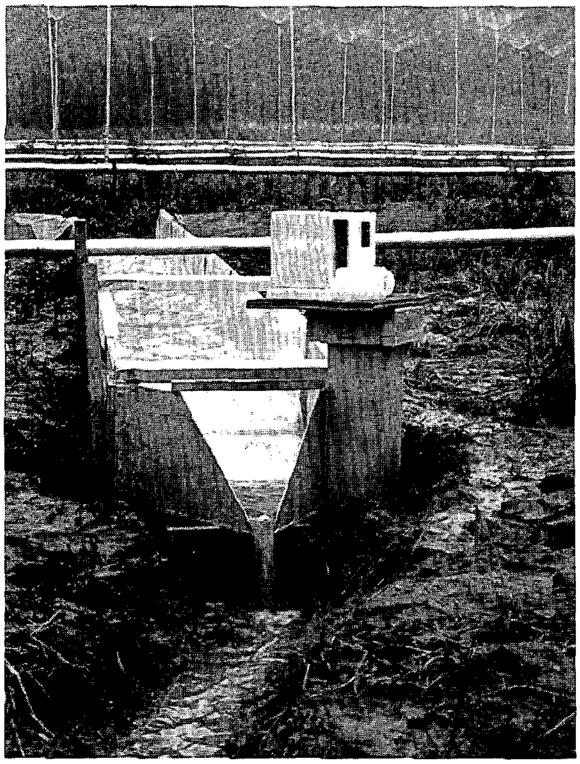
Years	No-Till Acreage		Other Conservation Till Acreage		Conventional Till Acreage		Total Acres Planted
1983	82,895	32%	58,455	22%	120,219	46%	261,569
1984	99,012	36%	53,270	19%	126,315	45%	278,597
1985	110,373	35%	52,194	17%	152,754	48%	315,321

Table 3. Rappahannock River Cropland Tillage.

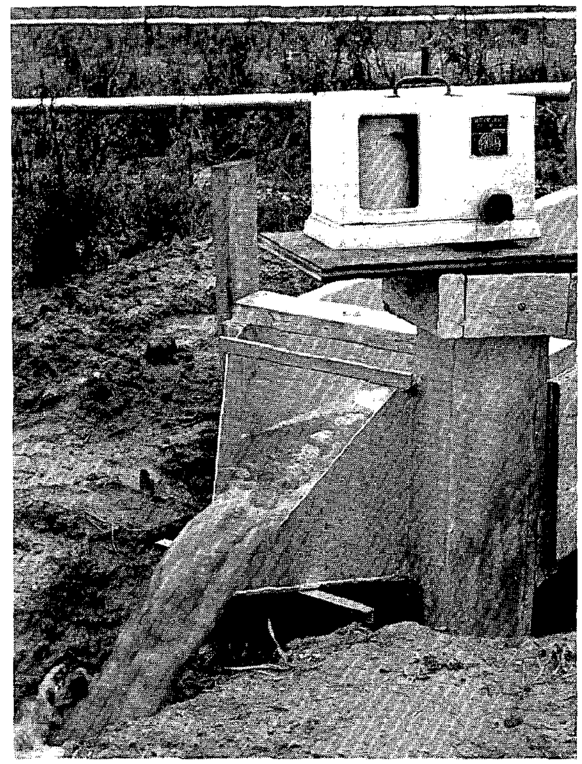


*Based on 1980 EPA average year agricultural load minus base loads.

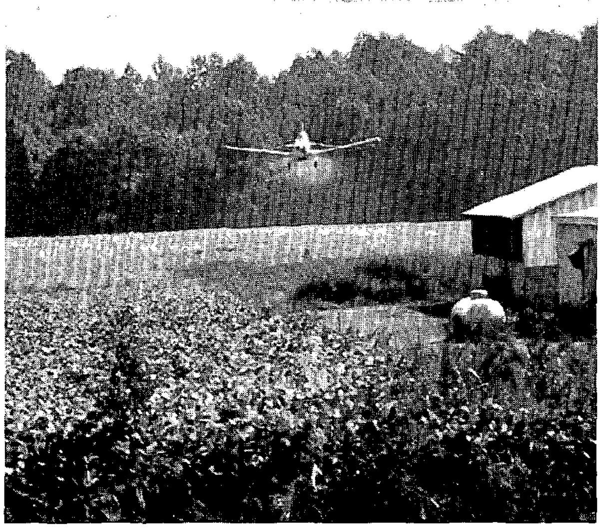
Figure 10. Reduced Phosphorus Loading to the Rappahannock River as a Result of Cost-Shared Cropland BMPs



Runoff from a no-till plot contains less sediment and phosphorus.



Compare the quantity and clarity of this conventionally-tilled plot.



Aerial seeding is one of the innovative BMPs encouraged for use by farmers in the Bay basin.

Similar to the BMP effectiveness demonstration held in the Shenandoah River basin, several rainfall simulator demonstrations were conducted in the Rappahannock River basin. During 1985 no-till farming was pitted against conventional tillage at a farm located in Tappahannock. Using the modified irrigation system, rain "fell" simultaneously at both sites. Runoff collected showed spectators (farmers, government officials, legislators, etc.) that less sediment and water flowed from the no-till site. Lab results support this. A similar demonstration event was held in Richmond County in 1986. (Reference similar section in the *James River Basin* section.)

Use of agricultural innovative BMPs were also encouraged by the Division of Soil and Water Conservation during the 1984-86 biennium. Aerial seeding into a cover crop is just one example of practices that were cost-shared to farmers.

Urban Runoff Controls

One of the 1984-86 Chesapeake Bay Initiatives provided cost-share grants to localities for demonstrating best management practices which abate urban runoff pollution. Porous asphalt pavement was installed at a Fredericksburg site in Summer 1986 and another pavement project was constructed this fall at a commuter lot in Warrenton.

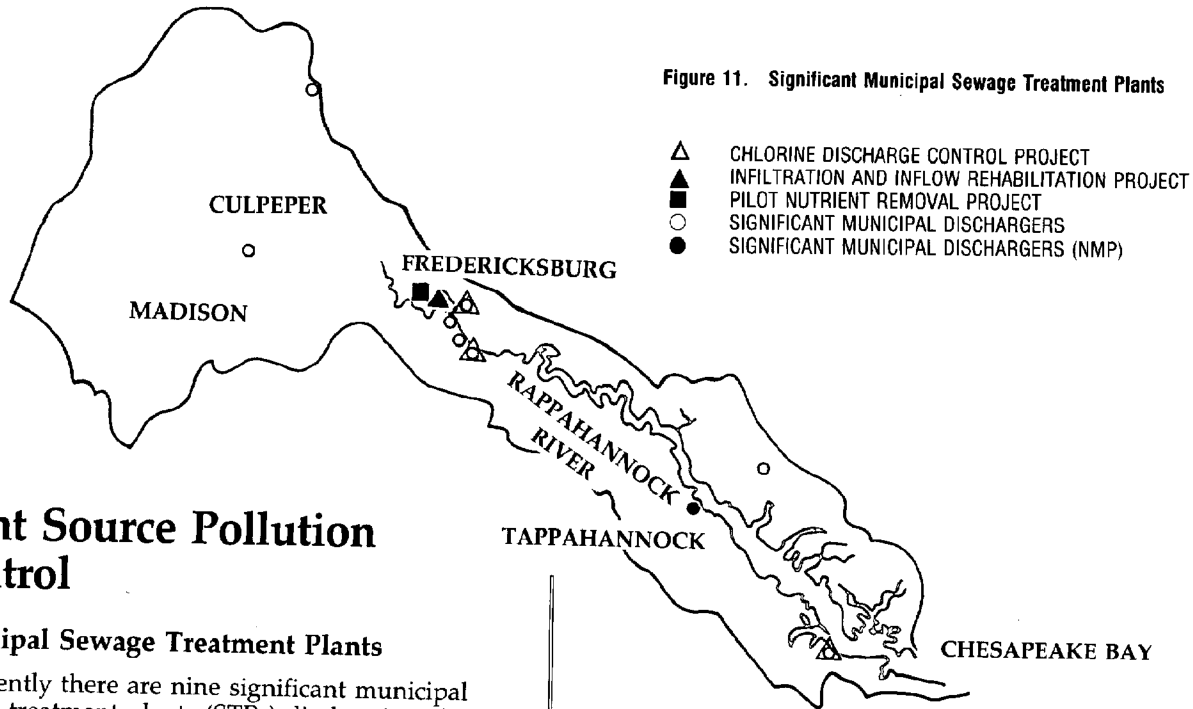


Figure 11. Significant Municipal Sewage Treatment Plants

Point Source Pollution Control

Municipal Sewage Treatment Plants

Currently there are nine significant municipal sewage treatment plants (STPs) discharging along the Rappahannock River. Figure 11 illustrates the locations of those plants and designates those which have yet, but are scheduled, to meet final effluent limits as required by the Clean Water Act National Municipal Policy by July 1988.

The Virginia Water Control Board also initiated a pilot project in 1985 to assess the efficiency and costs associated with nutrient removal at one Rappahannock STP. Fredericksburg received a state grant to monitor and analyze the simultaneous precipitation of phosphorus during its sewage treatment process. Study results will be available in 1987.

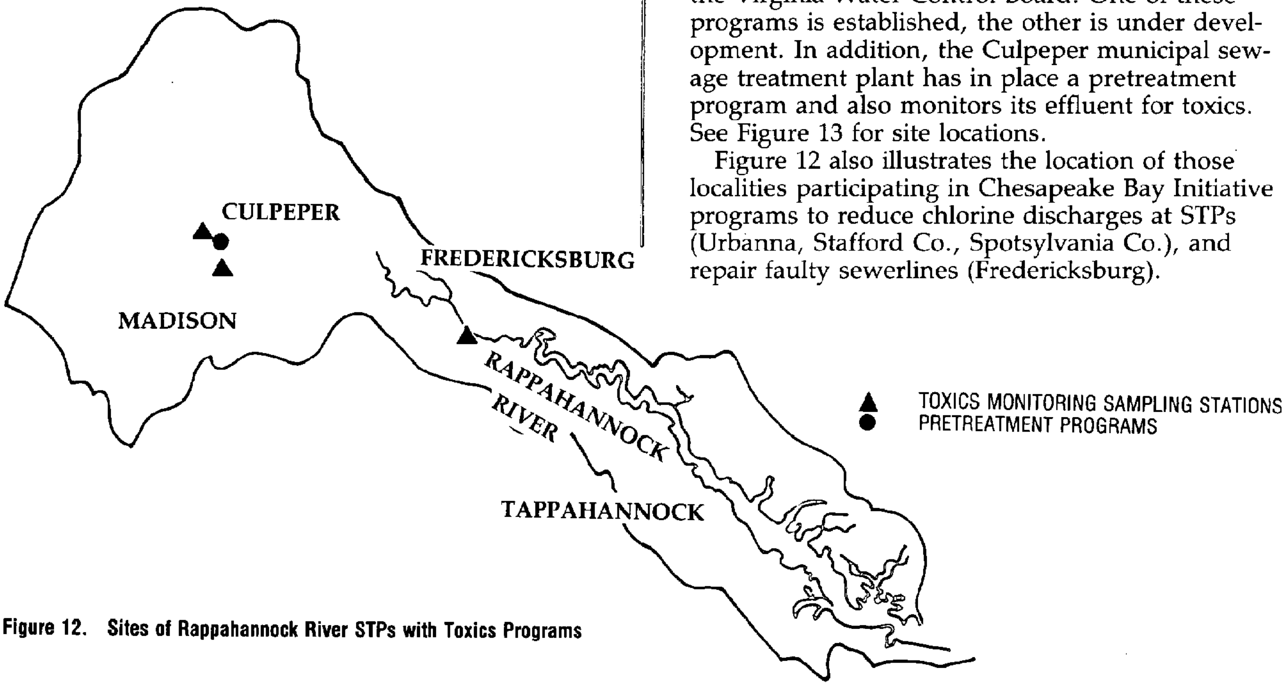


Figure 12. Sites of Rappahannock River STPs with Toxics Programs

Spotsylvania County is renovating and expanding the former FMC Inc. sewage treatment plant for its own use. Utilizing funds raised in a 1985 bond sale by the Virginia Resources Authority, the County was able to finance this project at below-market interest rates.

Toxics Removal, Monitoring, and Pretreatment Programs

In the Rappahannock River basin it is necessary for two industrial dischargers to monitor toxics in their plant effluents as ordered under permit by the Virginia Water Control Board. One of these programs is established, the other is under development. In addition, the Culpeper municipal sewage treatment plant has in place a pretreatment program and also monitors its effluent for toxics. See Figure 13 for site locations.

Figure 12 also illustrates the location of those localities participating in Chesapeake Bay Initiative programs to reduce chlorine discharges at STPs (Urbanna, Stafford Co., Spotsylvania Co.), and repair faulty sewerlines (Fredericksburg).

Resources and Habitat Improvement

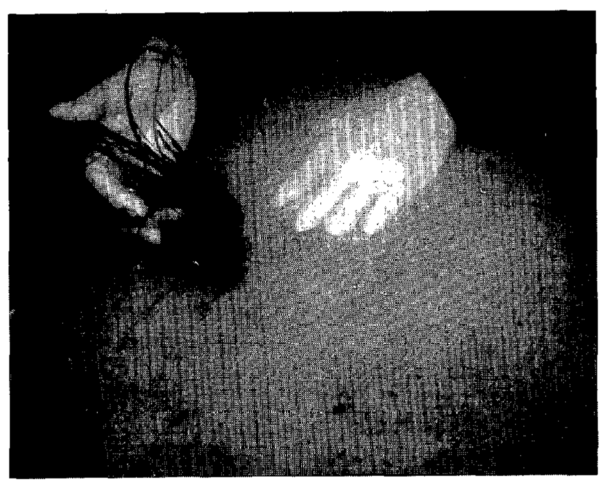
Shellfish Enhancement

The Rappahannock River is one of the Bay's most productive tributaries for shellfish. Portions of seven areas totalling 542 acres in the river basin that were previously closed to shellfishing due to deficient septic systems (or other residential sanitation devices along the shoreline) were reopened during the 1984-86 biennium. And since July 1986, an additional 17 acres of Parrotts Creek have been reopened. The cost to the State was $14,250 in addition to established administrative enforcement costs. The market value of the shellfish in these areas combined is $236,363, based on $13.00 per bushel of oysters. The areas reopened are portions of Carter's Creek, Corrotoman River, Mill Creek, and Greenvale Creek of Lancaster County; and Lagrange, Sturgeon, and Parrott's Creek in Middlesex County. Other reopened areas adjacent to the Rappahannock River basin are reported under the *Minor Tributaries* section of this report.

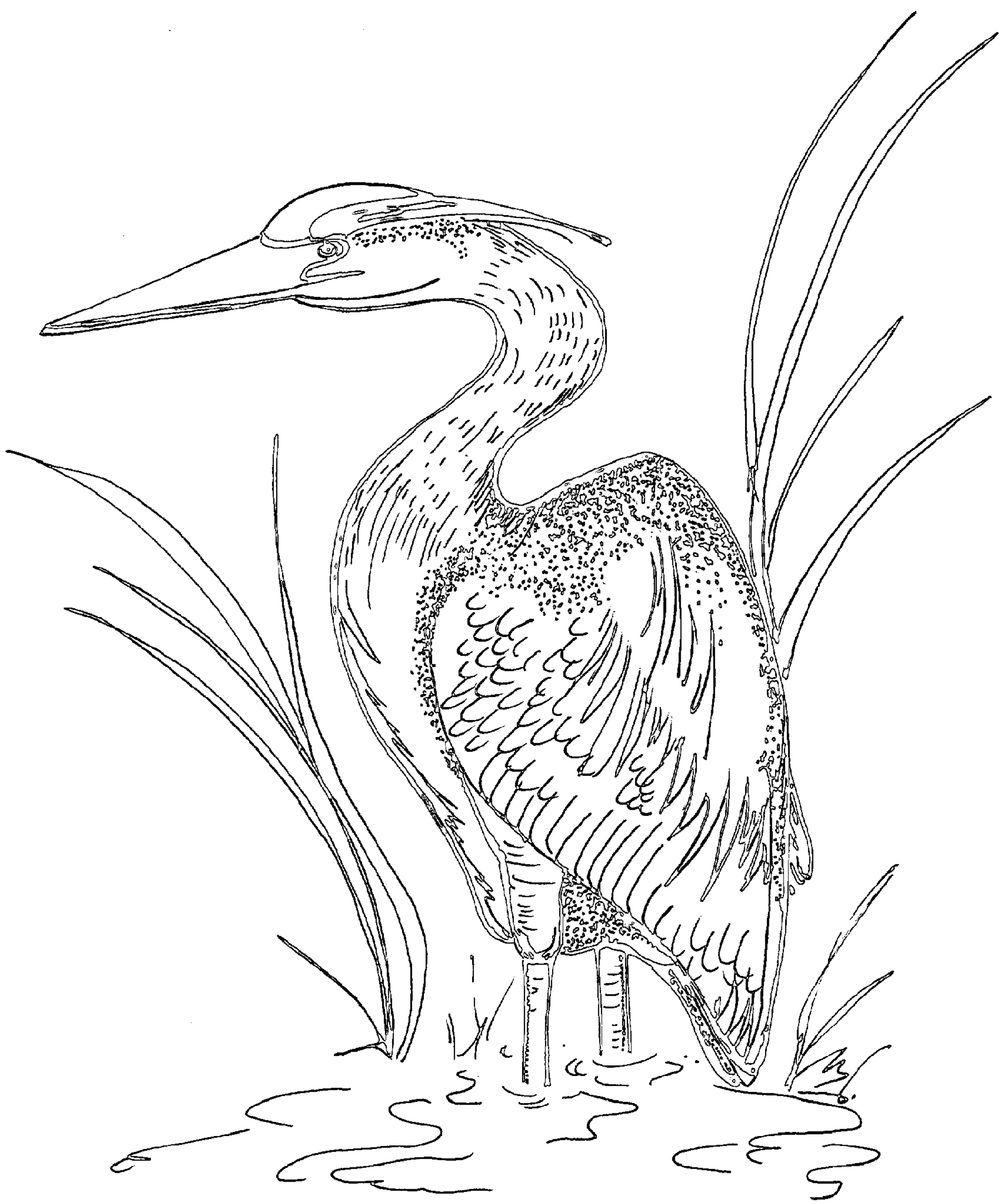
Submerged Aquatic Vegetation Reestablishment Program

Several locations in the Rappahannock River were planted with eelgrass in an attempt to reestablish submerged aquatic vegetation (SAV) there and to study the factors which caused its disappearance. During Fall 1984 four acres of transplanted eelgrass resulted in moderate reestablishment success at locations near Parrott Island and Morratico. During Fall 1985, 6 acres of eelgrass were planted near Belle Isle and test plots again near Morratico.

The reestablishment of SAV is critical to creating and maintaining finfish and blue crab fisheries. Historical records indicated that over 100 acres of SAV were present in the Rappahannock River. In 1980, no eelgrass was present.



The SAV reestablishment program is labor-intensive. So far, only plants transplanted by hand have survived.



Description

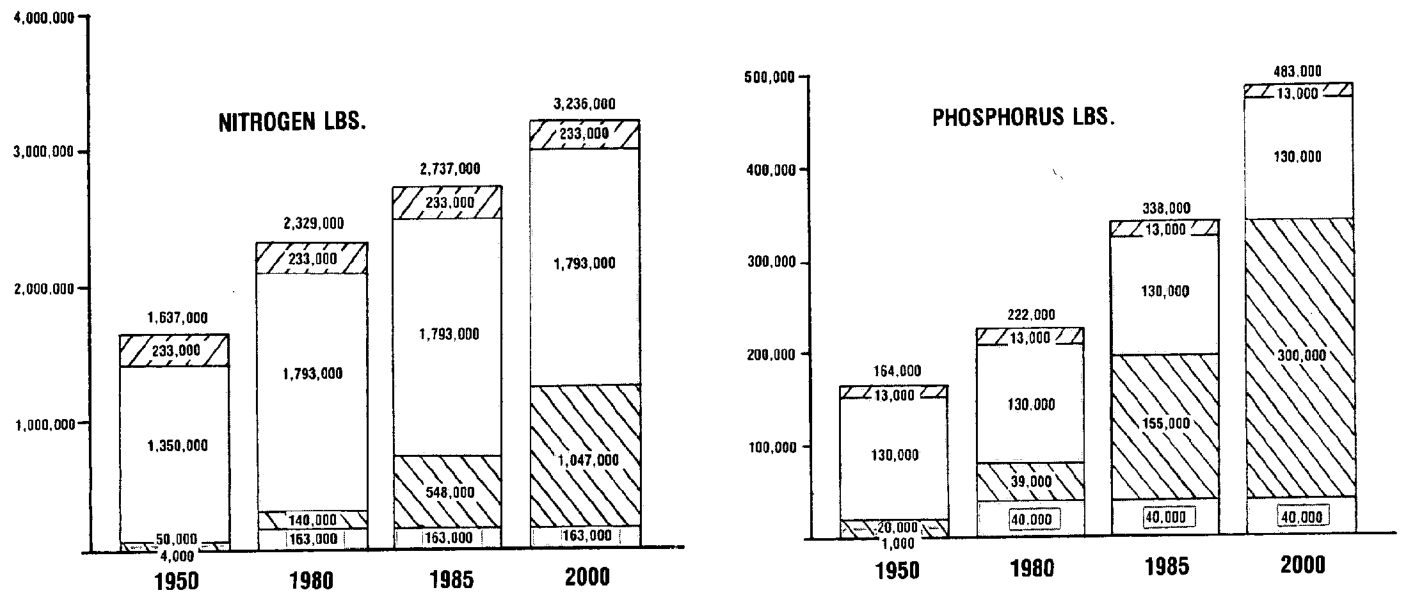
The York River basin drains the portion of central Virginia between the James and the Rappahannock Rivers. The York basin is slightly larger in area than the Rappahannock (2,986 square miles vs. 2,631 square miles) and in population (180,000 vs. 150,000). The York River basin is almost entirely rural, with West Point and Gloucester being significant population centers. The population in this basin is projected to increase by 57% to 285,000 by the year 2000.

The river supports a very small oyster fishery with wide fluctuations in harvest. Oyster reproductive potential is fairly stable but at low levels. At present, 8,823 acres of productive shellfish beds are closed due to fecal coliform contamination, primarily from residential sanitary systems, sewage treatment plant outfalls, or unsatisfactory water quality. Blue crab harvests have also remained relatively stable while finfish landings have steadily declined. Very little submerged aquatic vegetation (SAV) exists in the York River, but nearby Mobjack Bay supports some of the largest SAV beds in Virginia.

Nutrient Loadings

The most recent data (1985) suggest that nonpoint sources are the major contributors of nitrogen and point sources are the major contributors of phosphorus. Given the expected basin growth and development, phosphorus and nitrogen loadings are projected to increase 43% and 18% respectively above the 1985 levels by the year 2000 if no additional nutrient initiatives or controls are adopted. See Figure 13.

The tremendous increase in phosphorus and nitrogen loading from 1980 to 1985 is a result of the York River sewage treatment plant which went into service in 1983.



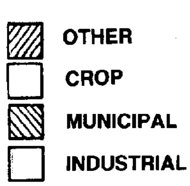


Figure 13. York River Nutrient Loadings and Sources

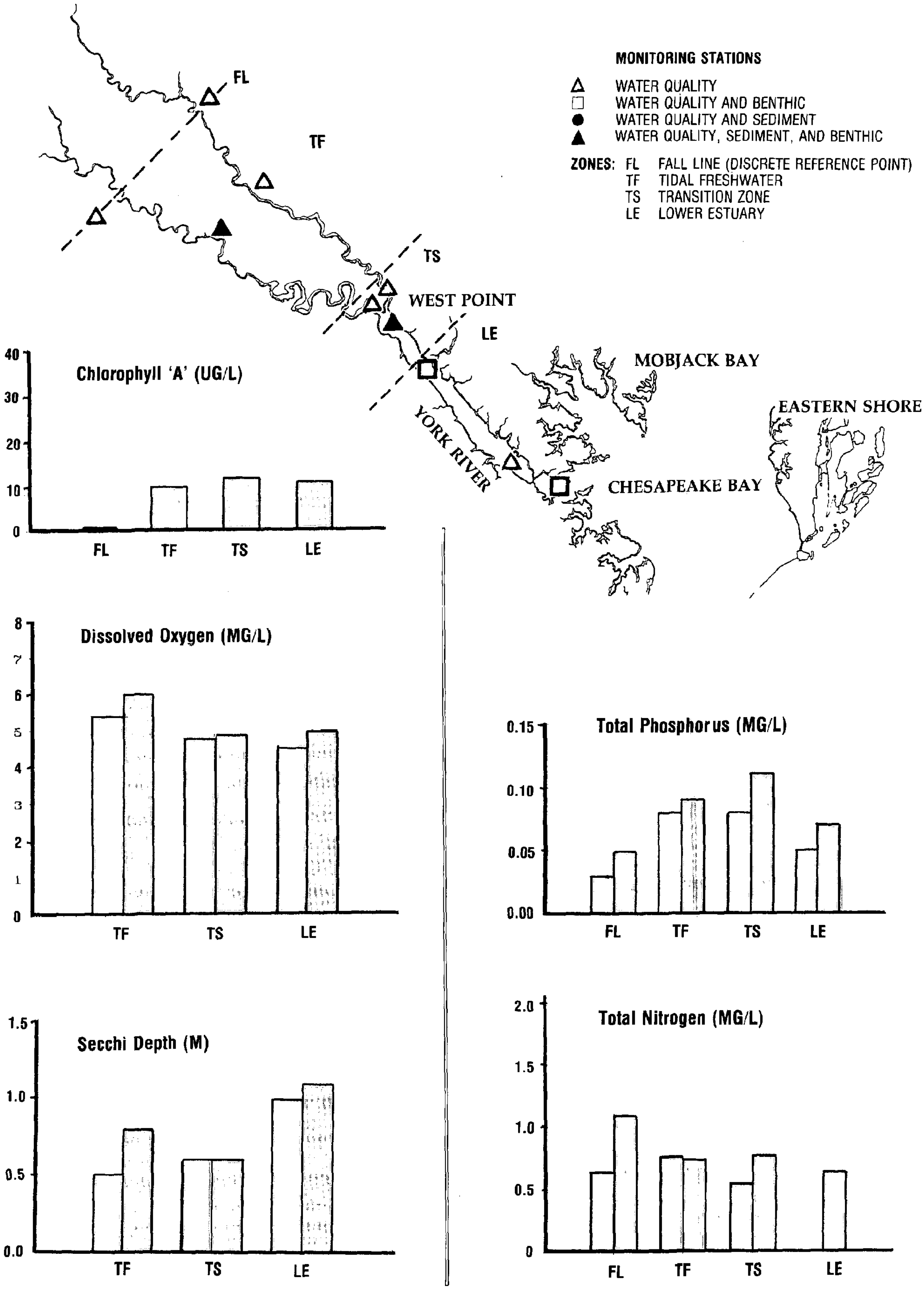


Figure 14. York River Water Quality

Water Quality Conditions

The York River is actually composed of two river systems. The fall line, tidal fresh zone, and much of the transition zone is located in both the Pamunkey and Mattaponi Rivers which combine to form the lower estuarine zone of the York River. The Pamunkey and Mattaponi Rivers do not have major development around the fall line, as do the other rivers, and has only minimal agricultural impacts. Thus the upper portions of these rivers are some of the most pristine in Virginia. The York River is impacted by point sources at West Point and near the river's mouth. This pattern is opposite from the Rappahannock River where the major impacts are located in the upper reaches. The lower areas of the York River are also less developed. Another major difference is the much smaller drainage area and freshwater flow of the Pamunkey and Mattaponi Rivers compared to the other tributaries.

The nitrogen concentrations are nearly level throughout the rivers. Much of the nitrogen in the upper reaches appears to be derived from plant decay and not from nitrate-rich agricultural runoff. Phosphorus concentrations increase in the tidal freshwater zone and peak near West Point where the first major area of development is encountered.

Chlorophyll-a concentrations are generally low throughout the York River. Occasional short-term algal blooms of up to 35 $\mu g/l$ (micrograms per liter) have been measured but the York River averages 10 $\mu g/l$. The low levels of chlorophyll-a in the tidal freshwater zone of the York River contrast with the higher levels seen in the other rivers. This reflects the low level of urban or agricultural development in the upper tributaries of the York River unlike the other rivers.

Dissolved oxygen in the lower York River is subjected to stratification similar to the Rappahannock River but it usually breaks up every few weeks with the occurrence of the spring tides. Thus dissolved oxygen depletion in the York River is a more short-term problem. Both the summer of 1984 and 1985 appear to have had similar oxygen concentrations with the transition and lower estuary zones exhibiting slightly lower than desirable levels of oxygen. (See Figure 14.)

Strategies

Because the York River basin is primarily rural, nonpoint source pollution control initiatives have been targeted here. All farmers are being encouraged to adopt cropland conservation practices which will reduce soil erosion and fertilizer runoff, and the entire basin has been evaluated and mapped on a pollution-potential basis.

The condemnation of shellfish growing areas continues to be an issue as residential sanitation system violations and marina development continue. To combat this, shoreline residential violations are receiving increased attention and new marina regulations are being promulgated. (See *Marina Pollution Abatement* in the *Bay-wide and Coastal Issues* section.) In another effort to improve the York River oyster fishery, oyster shells are being transplanted to provide good substrate for young oysters to develop.

Submerged aquatic vegetation (SAV) is being transplanted in order to provide food and habitat for finfish and blue crabs. A study to determine the factors causing the SAV decline is also concentrated here.

Even though point sources are the minor contributors in terms of quantity to the York River, the locations of these discharges are critical to marine organisms. A continued emphasis on improving sewage treatment plants is necessary to correct sewerline inflow and infiltration problems and to reduce chlorine and nutrient discharges.

Nonpoint Source Pollution Control

Agricultural Best Management Practices

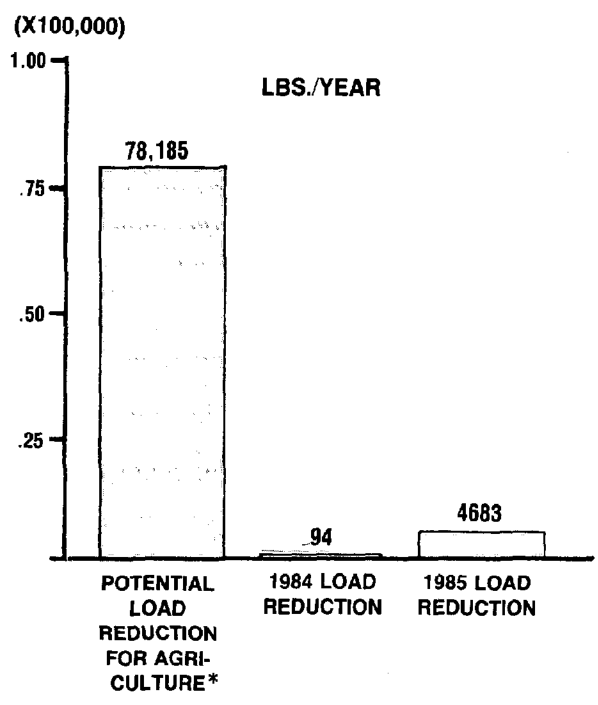
The contribution of nutrients to the Chesapeake Bay from the York River originates from cropland runoff and two major sewage treatment plants. The 1983 EPA Chesapeake Bay Study report states that cropland contributes 77% of the nitrogen and 44% of the phosphorus in the York River. In addition to this, soil carried in runoff contributes significantly to the sediment load in the river. During the 1984 and 1985 (calendar years) BMP program, 193 farmers installed Best Management Practices (BMPs) cost-shared by the State. The State contributed $159,832 or 64% of the cost for these practices which include reforestation of erodible cropland, grass filterstrips, and no-till planting. Gross soil erosion has been reduced through the 1984 and 1985 cost-share program by 50,510 tons per year. The BMPs implemented will also reduce the attached phosphorus load by 53,076 pounds per year. Another 29 farmers, out of 180 who requested grant assistance in 1986, have implemented BMPs benefiting 1,930 acres to date. Many BMPs are seasonal and will be installed later this year. (See Figure 15.)

The National Conservation Tillage Information Center collects statistics on cropland tillage practices. This information is used to help gauge the success of the BMP cost-share and education programs. (See Table 4.) Although these facts are estimates, a slight decrease in no-till planting is indicated since 1984 but at the same time, the total number of acres planted decreased by 8%. In addition, the lands of the York River basin have recently been evaluated in terms of pollution potential according to soil types, slope, and proximity to receiving waters. This information will be used by the Soil and Water Conservation Districts to target farms which should absolutely be using BMPs and recommend specific BMPs to those farmers. This program will begin with the 1987 cost-share sign-up period.

Years	No-Till Acreage	Other Conservation Till Acreage	Conventional Till Acreage	Total Acres Planted
1983	54,261 (27%)	70,720 (36%)	72,490 (37%)	197,471
1984	63,981 (27%)	77,850 (33%)	94,999 (40%)	236,830
1985	57,681 (26%)	73,626 (33%)	87,818 (41%)	219,125

Table 4. York River Cropland Tillage.

To assist farmers in implementing BMPs and help administer the agricultural cost-share program, Soil and Water Conservation District employees were supported, in part, with Chesapeake Bay Initiatives funds in the 1984-86 biennium. Such support will continue in the 1986-88 biennium.



*Based on 1980 EPA average year agricultural load minus base loads.

Figure 15. Reduced Phosphorus Loading to the York River as a Result of Cost-Shared Cropland BMPs

Stripcropping and contour planting are BMPs being encouraged.

Urban Runoff Controls

The purpose of the urban nonpoint source pollution control initiative was to demonstrate to localities the benefits of BMPs for urban and suburban development. Few areas of the York River basin can be classified as urban, nonetheless, Orange County participated in this cost-share program during 1985. A stone-centered grassed waterway was installed to demonstrate its effectiveness of detaining runoff as an urban drainage way.

Point Source Pollution Control

Municipal Sewage Treatment Plants

There are four significant municipal sewage treatment plants in the York River basin, that is, those STPs which discharge more than one million gallons per day (mgd) located anywhere in the drainage basin or less than one mgd located below the fall line. The most significant discharger in the York River basin is the York River STP, part of the Hampton Roads Sanitation District, at 15 mgd.

The York River STP is also a recipient of a $187,000 nutrient removal project grant under the Chesapeake Bay Initiatives. Modifications to the plant for biological nutrient removal of phosphorus have been completed and operations have been underway since August 1986. The process for removing nitrogen will begin before the end of 1986. Initial results for phosphorus removal indicate that the amount of phosphorus now being discharged from the plant has been reduced from 8 milligrams per liter (mg/l) to less than 2 mg/l, which is an

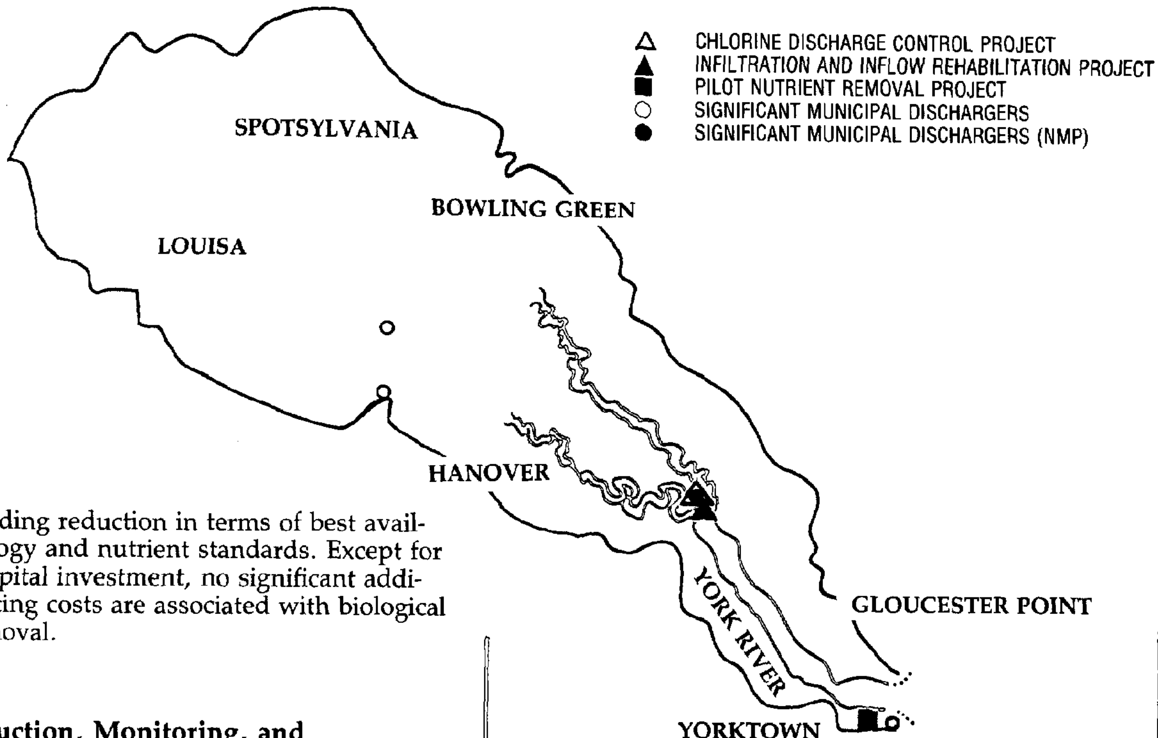


Figure 16. Significant Municipal Sewage Treatment Plants

excellent loading reduction in terms of best available technology and nutrient standards. Except for the initial capital investment, no significant additional operating costs are associated with biological nutrient removal.

Toxics Reduction, Monitoring, and Pretreatment Programs

The West Point STP has been awarded a 1986-88 cost-share grant for chlorine removal. A 75% cost-share grant will result in the removal of four lbs. of chlorine per day. This project, in combination with chlorine removed as a result of discharge permit requirements, reduced the amount of chlorine discharged from STPs in the basin by 79% for 1984-86 and 1986-87.

In the York River basin the Virginia Water Control Board has issued discharge permits requiring toxics monitoring at four industrial sewage treatment plants. Monitoring programs at two municipal plants are under development. Two municipal plants also have approved pretreatment programs. (See Figure 17.)

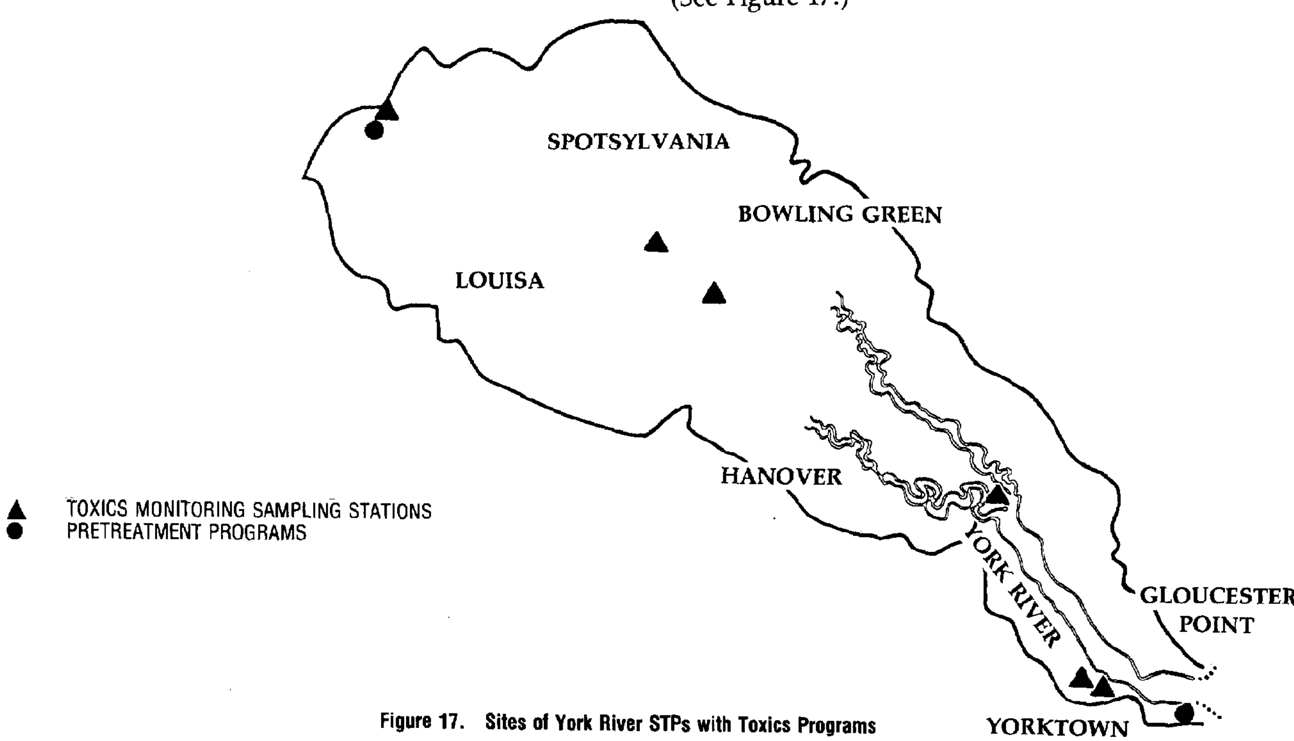


Figure 17. Sites of York River STPs with Toxics Programs

Resource and Habitat Improvement

Shellfish Enhancement

Similar to the Rappahannock River, the York River is a potentially productive shellfish growing area. Seven growing areas, previously condemned due to deficient residential sanitation facilities along the shoreline and direct discharges of sewage, have been reopened through the coordinated efforts of the Shellfish Enhancement Task Force and through stepped up enforcement efforts by the Health Department. The added cost to the state for these efforts is $12,592.

The reopened areas totalling 383 acres include portions of Cedarbush Creek and Sarah Creek, Gloucester County, and Felgates Creek, the York River at Cheatham Annex and Gloucester Point, York County. The market value of the now-available shellfish is over $31,850 based on $13.00 per bushel of oysters. (Other reopened areas adjacent to the York River are discussed in the *Minor Tributaries* section of this report.)

Two other areas currently targeted for shoreline improvements are portions of Timberneck Creek and King Creek. Residential sanitation system violations are being corrected at King Creek and have been completed at Timberneck Creek. Apparently animal pollution is contributing to poor water quality at the latter. Further investigations are planned to determine how much of this can be attributed to farm and undomesticated animals. The federal Soil Conservation Service has also been involved in the Timberneck Creek project assisting farm operators in best management plans for their farms.

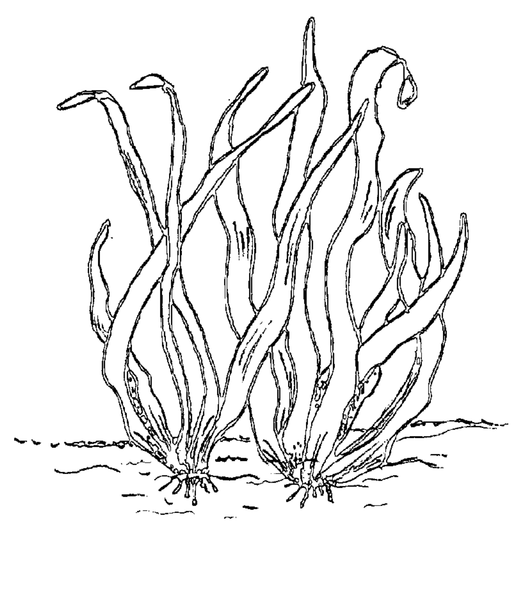
Submerged Aquatic Vegetation Reestablishment Program

Eelgrass was transplanted in Fall 1984 to three sites in the York River: Claybank, Mumfort Island, and Gloucester Point. Survival rates of individual transplants at the sites as of June 1985 ranged from 0% to 64%, averaging 18.4%.

The objectives of the SAV program are to reestablish these important grasses in areas that once supported dense beds, to better understand how the grasses respond to nutrient and turbidity stress, and to determine criteria for best management protocols relative to SAV resource conservation and enhancement.

A study of the production of eelgrass transplanted into an area of the York River that currently supports vegetation (Gloucester Point) and an upriver area that formerly but no longer supports stands of vegetation (Claybank) has been undertaken. Sites are monitored semi-monthly for nutrients, temperature, salinity, light, chlorophyl-a and suspended sediments. Results indicate a bimodal, annual pattern of plant production with significantly higher production levels during only the spring and fall at the Gloucester Point site. Summertime high temperatures stress the plants, and their failure is likely due to poor growth during the spring and fall. Other factors such as the growth of small plants and animals (epiphytes) on the leaves of transplanted vegetation are currently being investigated.

Efforts to reestablish SAV beds, including using seeds in the planting process, monitoring of the key environmental parameters, and refinements of a conceptual model on eelgrass growth, will continue in the 1986-88 biennium.



Description

The James River basin drains 10,495 square miles of central Virginia, approximately one quarter of Virginia's total land area. Its population is about 2 million and is projected to increase by 14% to 2.3 million by the year 2000. The James is characterized by extensive urban development at the fall line, (the Richmond, Petersburg, and Hopewell metropolitan areas,) and around Hampton Roads; elsewhere the basin is mostly agricultural and forestland. The James River suffers from significant nutrient problems, with point sources dominating. The river also suffers from toxics problems, particularly near Richmond, Hopewell, and Hampton Roads.

The degradation of the river's water and sediment quality is reflected in the loss of living resources. Commercial harvest of market oysters and oyster reproduction potential have declined over the years. Over 53,567 acres of productive shellfish beds are closed in the James River due to fecal coliform contamination from deficient residential systems, marinas, or sewage treatment and industrial plant outfall. Submerged grasses disappeared from the river prior to 1970, with the exception of a few grass beds near the mouth of the James.

The James River has the most water quality problems of Virginia's Chesapeake Bay tributaries. Virginia's Chesapeake Bay Initiatives target the basin for point source controls and toxic reduction strategies.

While the Elizabeth River is characterized by a distinct set of problems and conditions, it is geographically part of the James River watershed, and is therefore treated along with the James in this section. Its watershed lies entirely within the cities of Norfolk, Portsmouth and Chesapeake. Land use in its drainage basin is characterized by extensive urban development which includes six major industrial dischargers and four major federal facility dischargers. The Elizabeth River rivals Baltimore Harbor as one of the Bay's most severely toxic-contaminated areas. River sediments contain high levels of metals as well as sediment organics, including major creosote spills and PAH's (polyaromatic hydrocarbons) which are especially harmful to aquatic organisms.

Nutrient Loadings

Because high nutrient levels in the James River are nearly all attributable to municipal sewage treatment plants, Virginia's Chesapeake Bay Initiatives target the basin for point source controls. Phosphorus loads, if no additional nutrient control strategies are implemented, are expected to increase by 34% by the year 2000, and nitrogen by 27% above 1985 levels. (See Figure 18.)

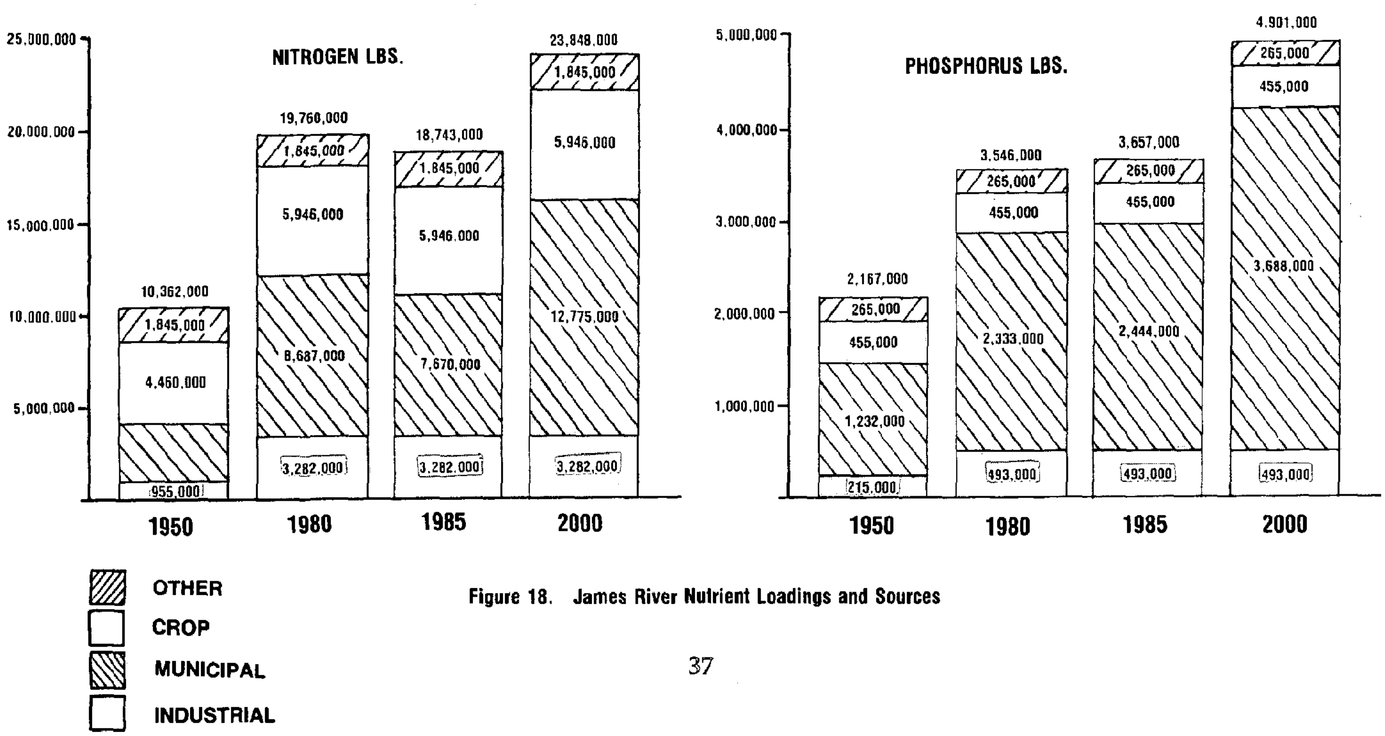


Figure 18. James River Nutrient Loadings and Sources

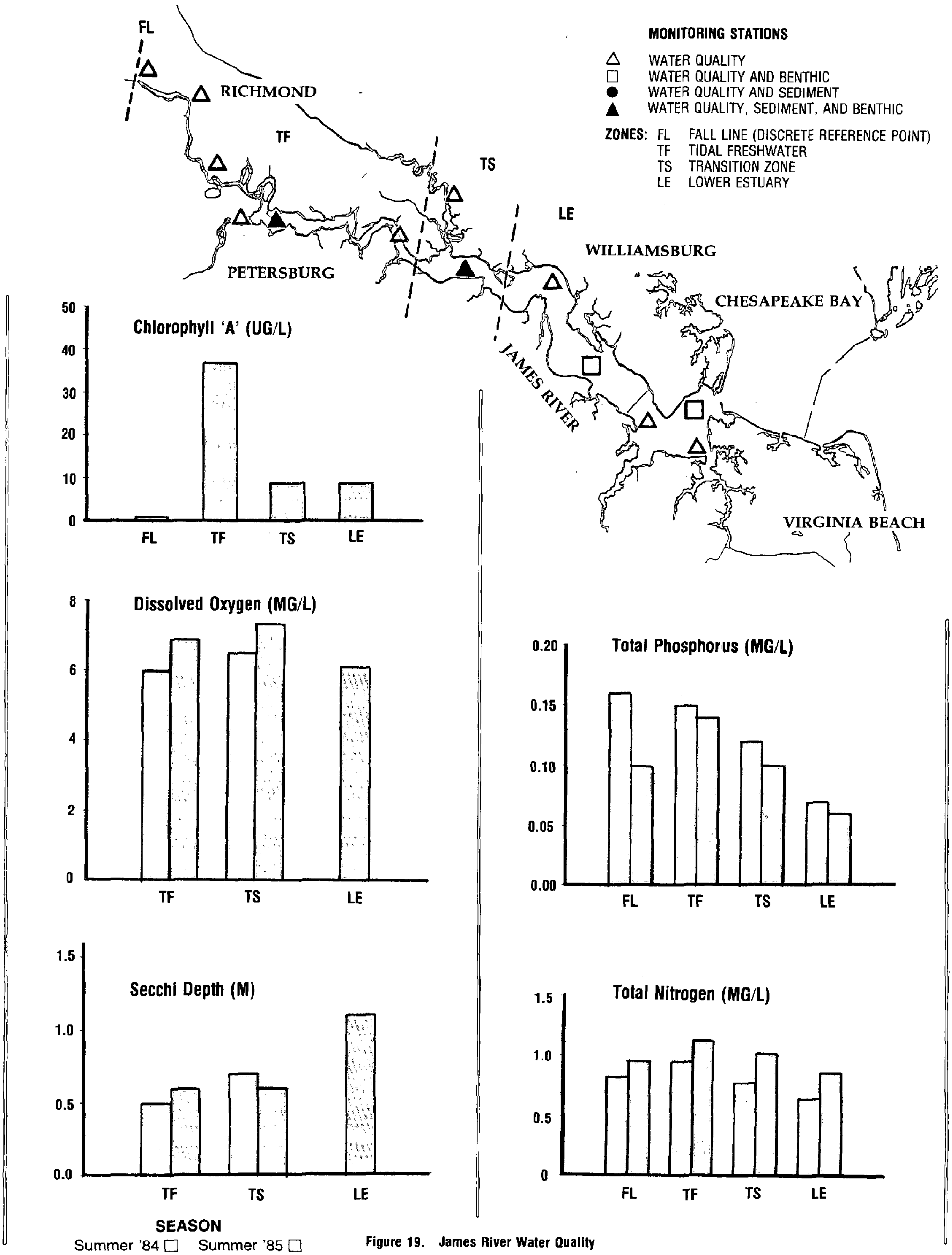


Figure 19. James River Water Quality

Water Quality Conditions

The James River exhibits the impacts of both urban point source and agricultural nonpoint sources of nutrients. Total nitrogen remains at a relatively constant level from the fall line to the river mouth with a slight increase in the tidal freshwater zone. This increase is probably due to the increased levels of ammonia, nitrite, and nitrate from point sources between Richmond and Hopewell. Phosphorus shows a relatively much higher peak in the tidal freshwater zone probably due to point sources but the contribution of nonpoint source phosphorus is also important. While the higher freshwater flow rates in the summer of 1984 slightly reduced nitrogen concentrations in the James River due to dilution, the higher flows tended to increase the phosphorus concentrations due to the transport of suspended sediment which is high in phosphorus. This is most noticeable at the fall line monitoring station.

Chlorophyll-a concentrations from above the fall line to just below Richmond are usually below the detection limit, then increase dramatically to peak between Hopewell and the confluence of the James and Chickahominy Rivers. Downstream of the Chickohominy River the average chlorophyll-a concentration drops sharply but short term minor blooms (35 μg/l) do exist. The average concentration for the tidal freshwater stations during the summer of 1985 was 33 μg/l (micrograms per liter). The station at the mouth of the Appomattox River typically had the highest concentrations (35 to 70 μg/l) with the stations between Hopewell and the mouth of the Chickahominy River also exhibiting a high level of chlorophyll-a (30 to 60 μg/l).

Dissolved oxygen in the James River does not experience the same stratification seen during the summer in the Rappahannock or York Rivers. This is due to the complex currents in the lower James River which tend to keep the water well mixed. During the summer of 1984 and 1985, all three zones of the river had roughly the same dissolved oxygen concentrations. Data from the James River Water Quality Monitoring Program has shown lower dissolved oxygen in the tidal freshwater James River located just downstream of Richmond and Hopewell. This is due to oxygen consuming processes typically associated with municipal discharges.

Strategies

The James River has a documented history of pollution from point sources, therefore, the primary strategies from improving water quality in the basin are focused on point source abatement projects. Projects include the construction and upgrade of municipal sewage treatment plants, repair of sewerlines to eliminate inflow and infiltration, reduction of chlorine discharged by sewage treatment plants, and the identification of and search of solutions for toxics in river water, sediment, and living resources.

Because a significant portion of the state's urban population lives in the James River basin, several urban nonpoint source pollution control projects have also been demonstrated here.

One of the world's most productive seed oyster beds is located in the lower estuary of the James River. These beds are being studied as well as the factors affecting them.

Wasteload allocations from point sources in the upper estuary of the James are also being adjusted according to recent data summaries and analyses.

Specific to the special conditions surrounding the Elizabeth River, a comprehensive Water Quality Management Plan is being developed. Both point and nonpoint sources of pollution are being addressed.

Nonpoint Source Pollution Control

Agricultural Best Management Practices

Runoff from cropland areas contributed 28.5% of the nutrients entering the Bay from the James River in 1985. During the 1984 (fall only) and 1985 calendar years, 404 farmers participated in the Best Management Practices (BMP) cost-share program implementing BMPs on 11,701 acres. The results of these practices will reduce the amount of soil escaping farm fields by 73,488 tons per year. (For reference, a truckload of top soil averages 9 to 10 tons.) Phosphorus escaping farms, attached to soil particles, is reduced by 87,233 pounds per year. Requests for 1986 BMP cost-share assistance were accepted through Spring 1986. Of the 406 farmers requesting grants, 61 are reported to have implemented practices to date benefiting 1,472 acres. The remaining farmers have until the end of the year to implement their practices.

Technical and administrative assistants are being supported by Chesapeake Bay Initiatives funds so that farmers can plan and implement better soil and fertilizer management plans.

To illustrate the advantages of no-till farming over conventionally-tilled fields, the Division of Soil and Water Conservation conducted a demonstration at Southampton County in 1985 and in 1986 held demonstrations at Chippokes Plantation at Surry County and another at Augusta County. Rainfall produced by a modified irrigation system fell simultaneously over the two fields and runoff samples were analyzed. (Visually, the no-till plot had clearer runoff and was less in terms of quantity of flow.) Lab analysis of the no-till runoff from these and other basin demonstrations showed reductions of 34% to 97% in soil loss, 24% to 82% in nitrogen loss, and 41% to 87% in phosphorus loss as compared to the conventionally-tilled plot.

The National Conservation Tillage Information Center provides other information helpful in assessing the number of acres using conservation practices.

Years	No-Till Acreage	Other Conservation Till Acreage	Conventional Till Acreage	Total Acres Planted
1983	69,504 (23%)	96,039 (32%)	131,125 (45%)	296,669
1984	93,293 (29%)	105,654 (33%)	122,206 (38%)	321,153
1985	96,501 (30%)	108,634 (34%)	112,730 (36%)	317,864

Table 5. James River Cropland Tillage.

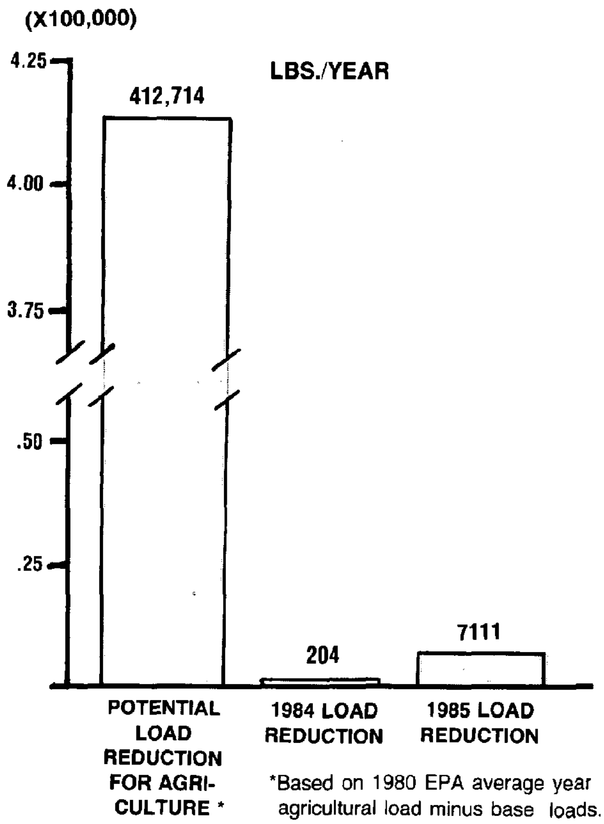


Figure 20. Reduced Phosphorus Loading to the James River as a Result of Cost-Shared Cropland BMPs

Nansemond River–Chuckatuck Creek Rural Clean Water Project

The Nansemond–Chuckatuck Rural Clean Water Project (RCWP) is a pollution control project to protect the area water supply reservoirs, and to clean up the waters for viable commercial and recreational shellfishing. Most point sources of pollution have been eliminated, and recent studies indicate that poor water quality in this area is a result of nonpoint sources.

The RCWP was developed with federal funding authorized under the Clean Water Act Amendment of 1977 and project implementation began in 1981. Similar to Virginia's agricultural cost-share program, the RCWP provides cost-share grant funds to aid in the installation of agricultural nonpoint source pollution controls such as cropland and feedlot Best Management Practices (BMPs). Approximately $1.47 million in U.S. Department of Agricultural funds is being cost-shared on a variable percentage basis (most at 75%) for 142 of the 200 farms located in the critical area (77,445 acres) of the RCWP area. Individual farmland improvement contracts are established between the farmer and the U.S. Soil Conservation Service (SCS), lasting from three to ten years. As of June 1986, 105 farm units, benefitting 14,870 acres, have been put under contract.

In addition to the SCS, the Nansemond–Chuckatuck project is administered and monitored with the cooperation of other agencies including the U.S. Department of Agriculture, Hampton Roads Water Qaulity Agency, Virginia Department of Health, Virginia Water Control Board, Virginia Tech, and the cities of Norfolk, Portsmouth, and Suffolk.

Baseline water quality conditions have been established so that water quality trends following implementation of the agricultural BMPs can be assessed. It is too early, however, to draw any quantitative conclusions at this time.

Urban Runoff Controls

Although only 3% of the James River basin is urbanized, approximately 9% of the nitrogen and 7% of the phosphorus entering the river comes from urban and forested areas plus urban areas contribute a significant amount of toxics. Several localities in the basin were awarded cost-share grants for the implementation and/or monitoring of best management practices to demonstrate nonpoint source pollution control. In Charlottesville a rainwater detention basin has been monitored for its efficiency at removing pollutants. Table 6 illustrates this "wet pond's" removal efficiency for an average year.

Pollutant	Removal at Outflow
Total Phosphorus	80%
Suspended Solids	87%
Zinc	65%
Lead	62%

Table 6. Charlottesville Wet Pond Pollutant Removal Efficiency.

Other urban best management practices cost-shared in the basin include construction and monitoring pollutant removal of porous asphalt pavement and a level spreader.

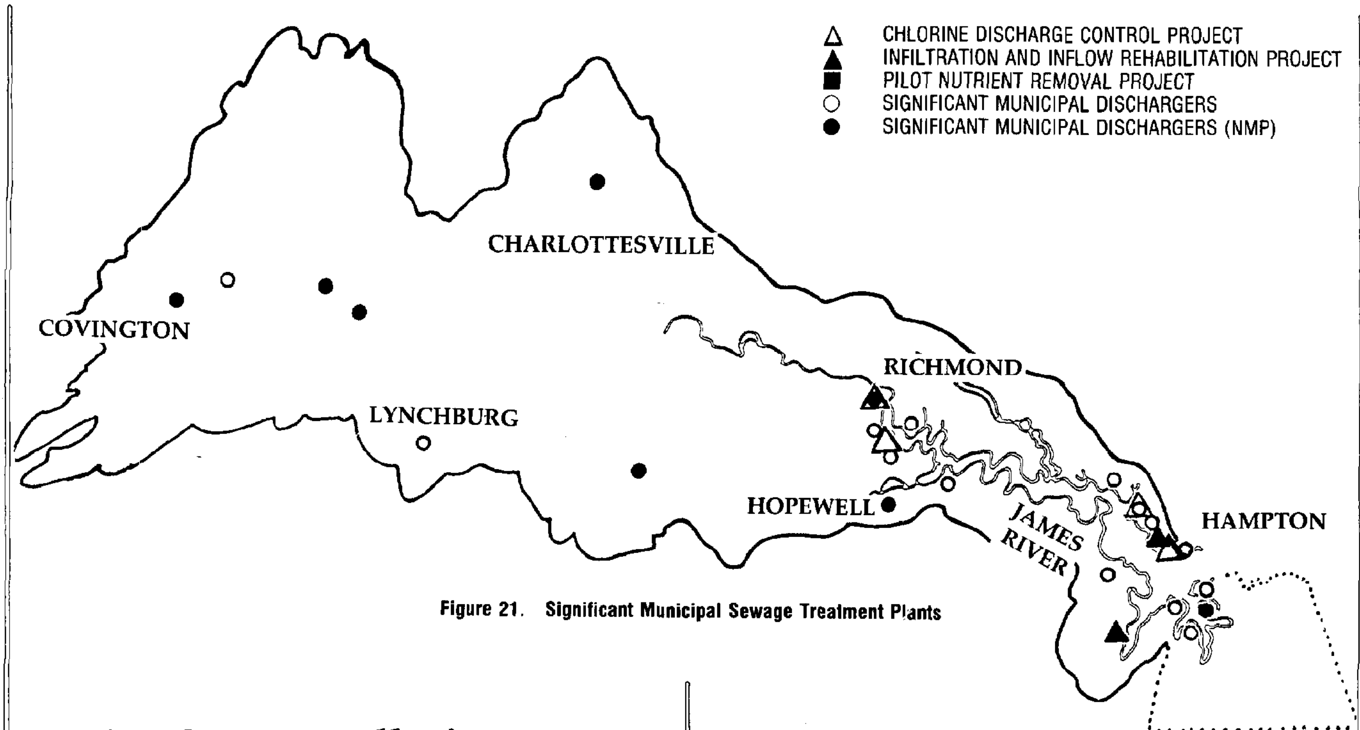


Figure 21. Significant Municipal Sewage Treatment Plants

Point Source Pollution Control

Municipal Sewage Treatment Plants

There are twenty significant municipal dischargers in the James River basin. Their design flow capacity ranges from 0.5 million gallons per day (mgd) to 70 mgd, the average flow being 16 mgd. Of these, eight plants have yet, but are scheduled, to meet advanced treatment requirements (National Municipal Policy) of the Clean Water Act by July 1988. (See Figure 21.)

A number of localities' sewerline systems are experiencing inflow and infiltration problems, a result of age and pipe deterioration. To assist in rehabilitative efforts, which ultimately results in less plant overflows, the State is awarding cost-share grants to localities. Newport News and Suffolk have all been awarded grants for the 1986-88 biennium.

Several localities are also making improvements at their sewage treatment plants (STPs) with assistance from a state bonding authority, the Virginia Resources Authority. In August 1985, Chesterfield County financed $20 million in bonds for capital improvements to their water and sewer systems and for the retirement of existing debt. Alleghany County is restoring and upgrading its water and sewer system. Through the Authority, financing is generally available at below-market interest rates.

An important Chesapeake Bay Initiative in the 1984-86 biennium was an intensive water quality monitoring program in the upper James River estuary, from the fall line at Richmond, down river to the Chickahominy River. Water and sediment samples were collected for two years to analyze for quality, toxics, metals, and nitrification. These data are being used to recalibrate a model which will assist in formulating wasteload allocations for the municipal and industrial plants that discharge to the river. Resulting regulatory decisions are anticipated to begin in mid 1987.

Chlorine Reduction at Municipal Sewage Treatment Plants

The amount of chlorine being discharged in sewage treatment plant (STP) effluents is being reduced by two methods: voluntary reduction by plant operators, and through the addition of dechlorination or alternative disinfection technologies. Two municipal STPs are voluntarily reducing chlorine in their effluents to a level where adequate disinfection is still achieved. Four other municipal STPs are adding dechlorinating equipment, whose cost is shared by a state Chesapeake Bay Initiatives' grant: Richmond, Chesterfield County's–Proctor's Creek plant, and the Hampton Roads Sanitation District's James River and Boat Harbor plants. As a result of these 75% state grants, 1489 lbs. of chlorine no longer will be discharged per day to the river. Figure 21 shows the locations of STPs receiving State grants for chlorine reduction.

Toxics Control, Monitoring, and Pretreatment Programs

The Virginia Water Control Board has instituted a program to identify toxic compounds in industrial, municipal, and federal installations' discharges as part of the Chesapeake Bay cleanup effort. The focus of the 1984-86 biennium was on the James and Elizabeth Rivers. In the 1986-88 biennium, work is continuing in these rivers, but the program has been expanded to the Potomac, Rappahannock, and York Rivers plus the Eastern Shore.

In the first biennium of this project, it was learned that many toxics found in sediment and fish tissue cannot always be easily traced to point source effluents because of the influence of multiple sources of toxics compounds from point and nonpoint sources. Volatile organics were predominantly detected at sewage treatment plant outfalls, and wastewater from facilities on the Elizabeth River which treat ship ballast waste are major contributors of hydrocarbons such as petroleum products.

Discharges will be selected for evaluation through a Toxicity Management and Reduction Program. An automated toxics data base has been established and will be maintained. See Figure 22 for a location of 1984-86 toxics sampling locations.

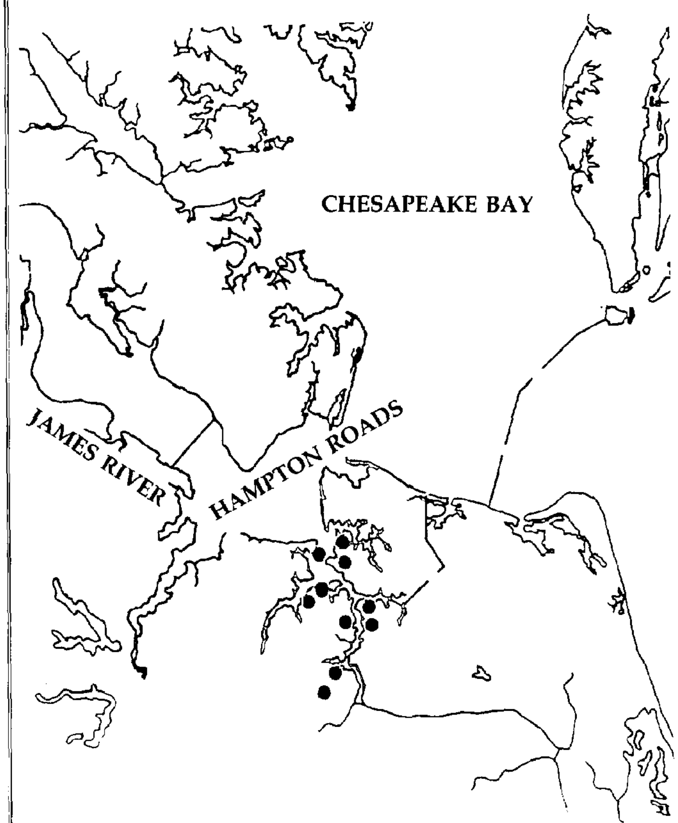


Figure 23. Toxics Sampling Locations in the Elizabeth River

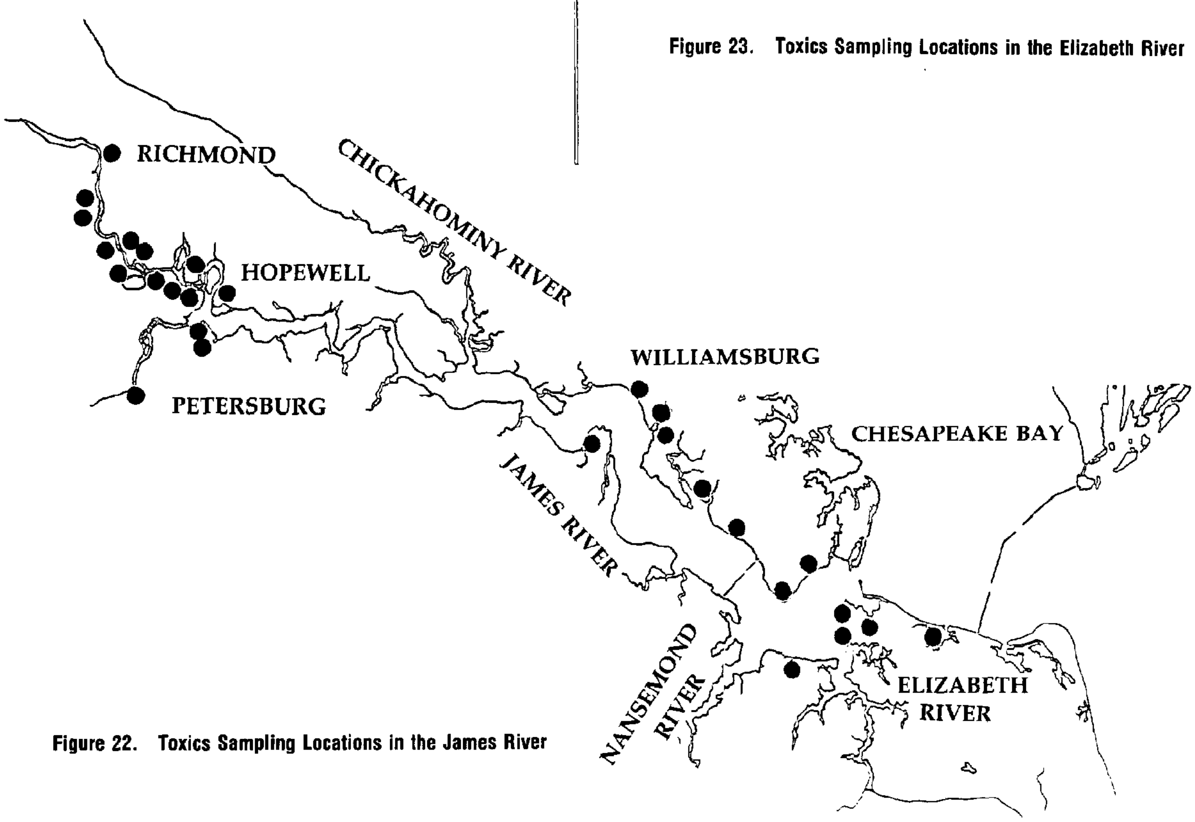
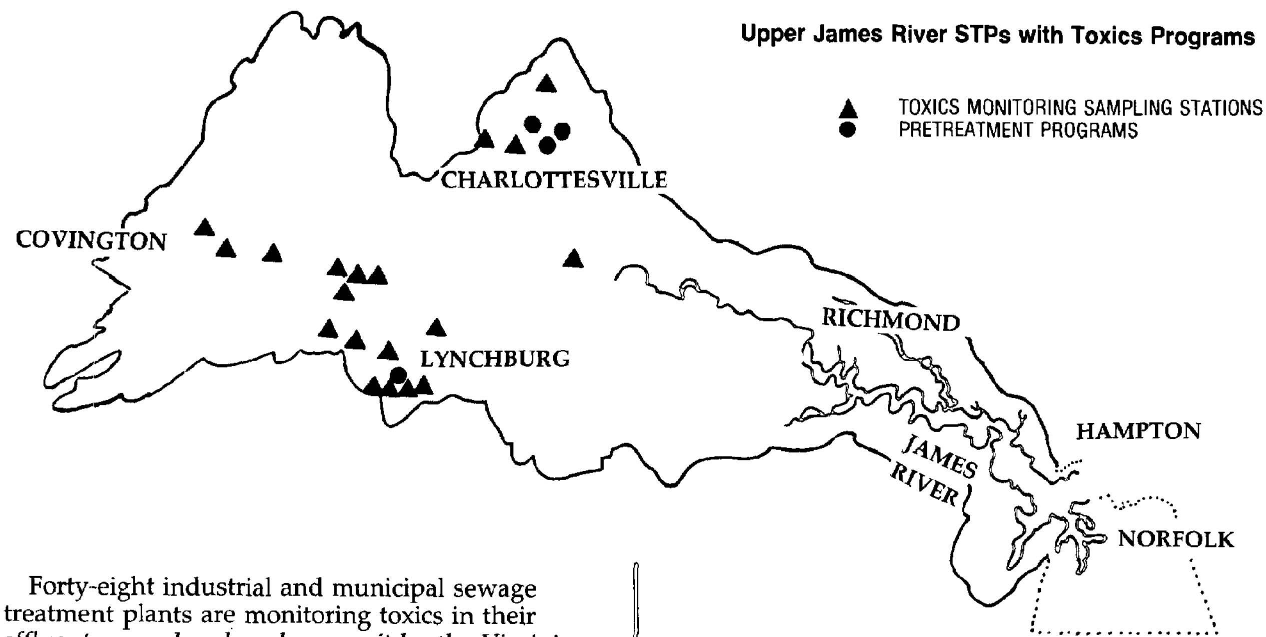


Figure 22. Toxics Sampling Locations in the James River



Forty-eight industrial and municipal sewage treatment plants are monitoring toxics in their effluents as ordered under permit by the Virginia Water Control Board. Monitoring programs at fifteen other STPS are under development. This includes plants both above and below the fall line. In addition, sixteen municipal STPs have approved pretreatment programs. (See Figure 23.)

Since 1975, the Virginia Water Control Board has been sampling finfish and sediments to determine trends in Kepone levels in the James River. This information is necessary to protect the health of seafood consumers and to support decisions to lift, modify, or continue fishing restrictions. Disturbances of bottom sediments may release settled Kepone into the water column again, so after the 1985 flooding, additional sampling was undertaken: no increase in Kepone concentrations was indicated, or movement of Kepone residues into previously uncontaminated areas.

Kepone is an extremely potent pesticide which was produced for more than a year by Allied Corporation and Life Science Products in Hopewell. Kepone was used as an ant and roach poison until banned from U.S. production in 1975. Also at this time it was discovered that some of the pesticide was escaping the plant in processed wastewater discharged to the James River. The river was immediately closed to fishing and crabbing, but has since had some areas reopened for harvest as the levels of Kepone have dropped below closure levels for some species.

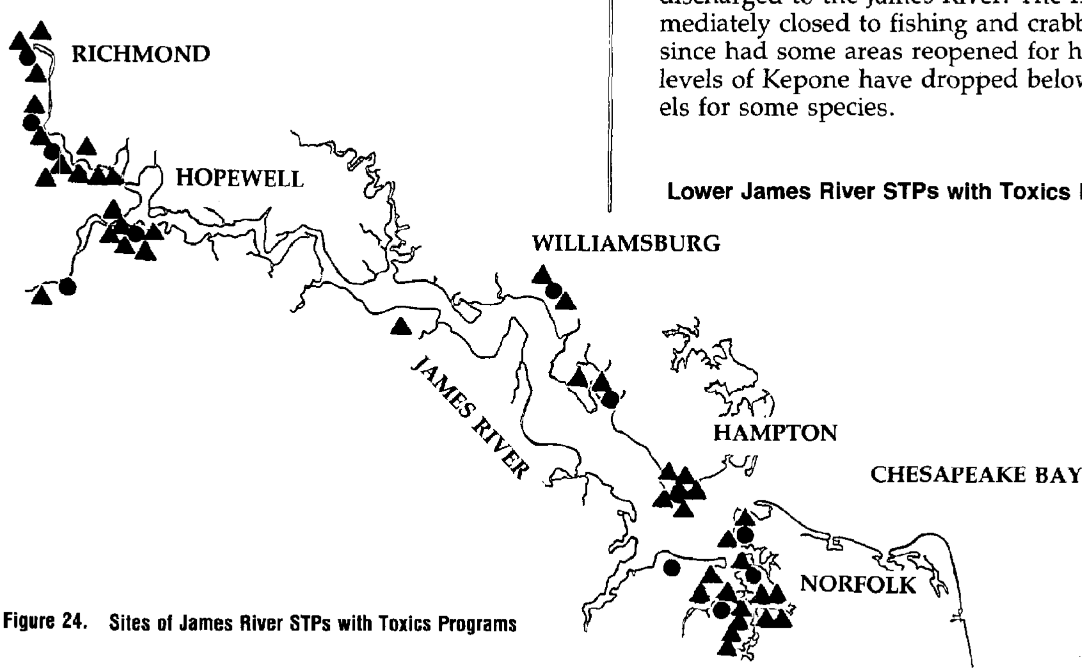


Figure 24. Sites of James River STPs with Toxics Programs

Elizabeth River Water Quality Management Plan

The Elizabeth River, whose drainage area is approximately 200 square miles, is a unique tributary at the lower estuary of the James River. No free flowing streams enter the river, thus, the inflow of freshwater is limited primarily to stormwater runoff from within the basin.

For years, concern has been expressed about the ill health of the Elizabeth River. This body of water suffers from low dissolved oxygen, high nutrients and sulfur-sulfite values, high bacteriological counts (shellfishing has been banned since 1914), heavy metals, oil spills, creosote leachate, and high temperature cooling water discharges. Many of these problems have been generated because of heavy industrialization of the surrounding area.

Beginning in the mid 1980s, the local governments of Southside Hampton Roads and the State began a cooperative effort to prepare strategies to manage the water quality of the Elizabeth River.

The Southeastern Virginia Planning District Commission and the Hampton Roads Water Quality Agency have been working with the Virginia Water Control Board on the development of preliminary management recommendations for the Comprehensive Elizabeth River Water Quality Management Plan (CERWQMP). To date, studies have been completed on current water quality conditions and problems, nonpoint source pollution, and waterfront development as it relates to water quality conditions. A preliminary plan and management approach will be completed in December 1986. The final plan is scheduled for completion in late 1987.

Resource and Habitat Improvement

Shellfish Enhancement

Nonpoint source pollution, deficient residential sanitation systems, and municipal and industrial sewage treatment plant discharges are the main sources contributing to the closure of shellfish grounds in the James River. Whenever possible, these problems are being addressed by the Shellfish Enhancement Task Force. Two shellfish areas totalling 621 acres have recently been reopened as a result of improved water quality and the correction of shoreline residential sanitation systems upriver: portions of the upper Nansemond River in Suffolk and the Pagan River in Isle of Wight County. State grants assisted low and moderate income households. Based on $13.00 per bushel of oysters, the market value of the shellfish now available is $325,000. The added Chesapeake Bay Initiatives cost to the State was $57,995. Work is also underway to eliminate pollution sources resulting in shellfish area condemnations at the Chuckatuck and Brewer's Creeks area.

The Lynnhaven River produces oysters nationally renowned for their flavor, but due to nonpoint source pollution, primarily urban, the shellfish area remains closed to harvesting most of the year. Cooler water temperatures retard fecal coliform growth, however, and during a portion of just about every winter harvest season the Lynnhaven River is temporarily reopened for shellfishing. For example, in early 1986, 1,408 acres of the river were opened making $425,000 in shellfish available.

Minor Tributaries, Coastal Embayments, and the Eastern Shore

Description

This section reports the status of programs implemented in the minor tributaries of the Chesapeake Bay in Virginia, coastal embayments of the Bay and the Eastern Shore, as well as the land mass of the Eastern Shore. Because the minor tributaries and embayments have their own distinctive circumstances regarding adjacent land uses, sources contributing to pollution, and living resource information, no attempt is made here to combine these facts as such, and in many cases specific details are unavailable. Data that are available are reported in this section. For a characterization of the land uses of a specific tributary, refer to the report sections describing the nearest major tributary, i.e., the Potomac, Rappahannock, York, and James Rivers.

"Minor tributary" refers to those creeks and rivers which flow directly into the Chesapeake Bay itself or into a small coastal bay not hydrographically connected to the major tributaries listed above. The minor tributaries on the western shore of the Bay include the Piankatank, Wicomico, Back, and Poquoson Rivers and embayments such as the Mobjack and Brown's Bays. Eastern Shore waterways include Hunting and Occohannock Creeks.

Eastern Shore. Virginia's Eastern Shore drainage area is less than a thousand square miles. It includes numerous small to moderate waterways such as Pungoteague and Nassawadox Creeks. The Eastern Shore population was 48,900 in 1980 and is expected to increase by approximately 16% to 56,800 by 2000. Almost all of the Shore is rural and less than 1% of the land use is urban, Onancock and Chincoteague being population centers.

Nutrient Loadings

Water quality varies from embayment to embayment so characterizing the minor tributaries is an impossibility. But collectively nutrient loadings from point sources can be compared and nonpoint sources can be estimated. If no additional nutrient control measures are implemented by 2000, phosphorus loadings will increase 50%, and nitrogen 26%, over 1985 levels.

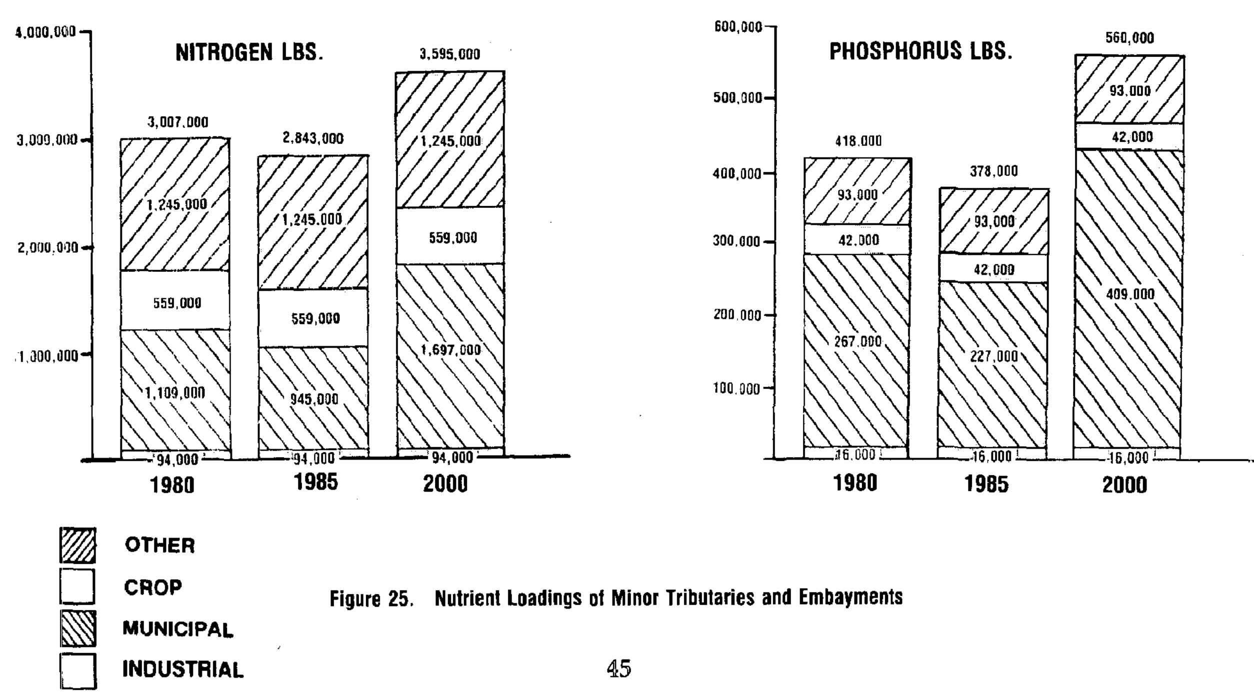


Figure 25. Nutrient Loadings of Minor Tributaries and Embayments

Strategies

All farmers in the Commonwealth are encouraged to adopt Best Management Practices. The Chesapeake Bay Initiatives provide financial incentives and education toward this end. Farmers in the entire Bay basin and the western half of the Eastern Shore (the portion draining to the Bay) are eligible for cost-share grants.

Point sources of pollution are being reduced through several of the Initiatives which provide financial assistance to localities: chlorine discharge reduction, sewerline infiltration and inflow rehabilitation, and nutrient removal.

Some of the productive shellfish beds have been reopened and others are presently targeted with pollution mitigation and control efforts.

Nonpoint Source Pollution Control

Agricultural Best Management Practices

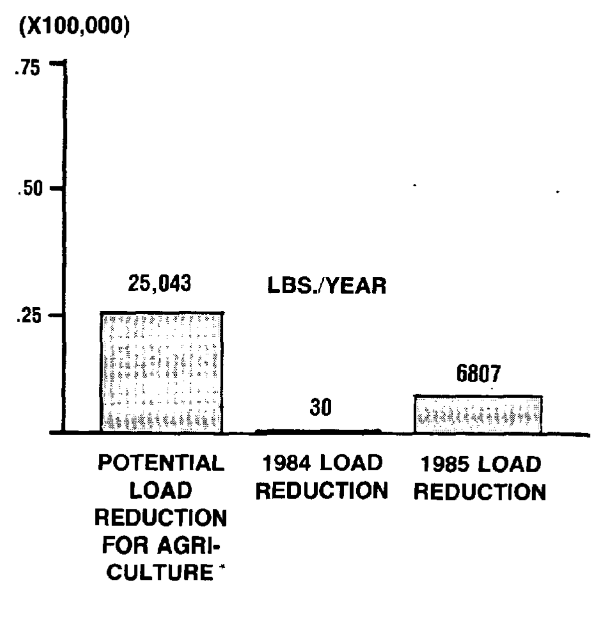
The 1983 Chesapeake Bay study report states that for the Eastern Shore, cropland is responsible for the majority of the excess nitrogen and phosphorus loading into the Bay. Since the Chesapeake Bay Initiatives program began in June 1984, 162 farmers installed Best Management Practices (BMPs) benefiting 10,364 acres in 1984 (fall only) and 1985.

As of October 1986, another 13 farmers had installed BMPs benefiting 416 acres. An additional 5 farmers who signed up for 1986 cost-share assistance have until the end of the calendar year to install their practices in order to receive a grant award. The shared cost to the State for 1984 and 1985 was $92,215, for 1986 to date, $8,024. One animal waste control facility has also been installed. The above figures and those in Figure 26 include participation in the minor tributaries and coastal embayments as well.

From the National Conservation Tillage Information Center, Table 7 shows that the Eastern Shore had 53% of its total cropland acreage in conservation tillage in 1985, a dramatic 31% increase over 1984. At the same time, however, the amount of acres planted decreased by 1.0%.

Years	No-Till Acreage	Other Conservation Till Acreage	Conventional Till Acreage	Total Acres Planted
1983	18,083 (20%)	420 (1%)	71,586 (79%)	90,089
1984	17,483 (21%)	819 (1%)	66,148 (78%)	84,450
1985	27,675 (33%)	16,740 (20%)	39,093 (47%)	83,507

Table 7. Eastern Shore Cropland Tillage.



*Based on 1980 EPA average year agricultural load minus base loads.

Figure 26. Reduced Phosphorus Loading to the Minor Tributaries and Embayments as a Result of Cost-Shared Cropland BMPs

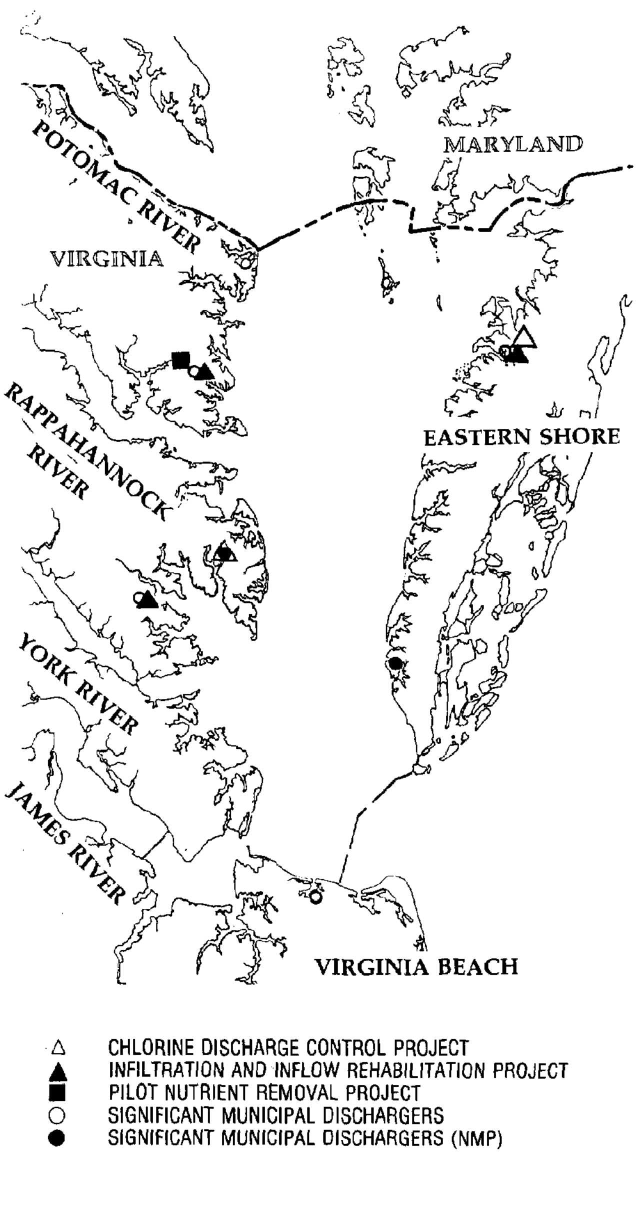


Figure 27. Significant Municipal Sewage Treatment Plants

Point Source Pollution Controls

Municipal Sewage Treatment Plants

There are eight significant municipal dischargers located in the minor Bay tributaries and the Eastern Shore. The largest municipal sewage treatment plant (STP) of this area is the Chesapeake/Elizabeth River plant of the Hampton Roads Sanitation District (30.0 mgd). The smallest is the Tangier Island STP (0.1 mgd).

The Gloucester County STP is correcting its sewerline infiltration and inflow (I&I) problems with assistance from 1984-86 Chesapeake Bay Initiatives grant of $123,000. The County is contributing approximately $100,000 to the project which should eliminate 40% of the I&I flow to the plant. Excess inflow to an STP robs treatment capacity and may cause raw sewage overflows or pump station by-passes during heavy rainstorms.

The Town of Onancock on the Eastern Shore is also a recipient of a 55% state cost-share grant for I & I rehabilitation. Corrections are scheduled to be completed in early 1987. Approximately 35% to 40% of the excessive I & I is estimated to be eliminated by this effort.

The Town of Kilmarnock, located on the western shore of the Bay and north of the mouth of the Rappahannock River, was awarded two local assistance Chesapeake Bay Initiatives grants. With 1984-86 funding, Kilmarnock will be removing phosphorus and nitrogen via the Biological Nutrients Removal System process. Design work was completed in Summer 1986 and plant modification work is scheduled for Winter 1986-87. Kilmarnock was also recently awarded funding under the 1986-88 Chesapeake Bay Initiatives program to rehabilitate its sewerlines to reduce inflow and infiltration.

Toxics Reduction, Monitoring, and Pretreatment

Figure 28 illustrates the locations of sewage treatment plants monitoring toxics in their effluents. Two of the plants' monitoring programs (Perdue and Chesapeake/Elizabeth) are underway via state permits and two others are under development. In addition, the Chesapeake/Elizabeth River STP pretreats its influent for toxics.

The Town of Onancock received a 1984-86 Chesapeake Bay Initiatives grant of $264,150 to install ultraviolet light treatment equipment to its STP. This 85% cost-share award will allow Onancock to disinfect plant effluents without using chlorine.

Mathews County will receive a 1986-88 Chesapeake Bay Initiatives cost-share award for chlorine discharge control at its sewage treatment plant. The County is presently investigating the use of ultraviolet light added to wastewater disinfection as a replacement for their chlorination system.

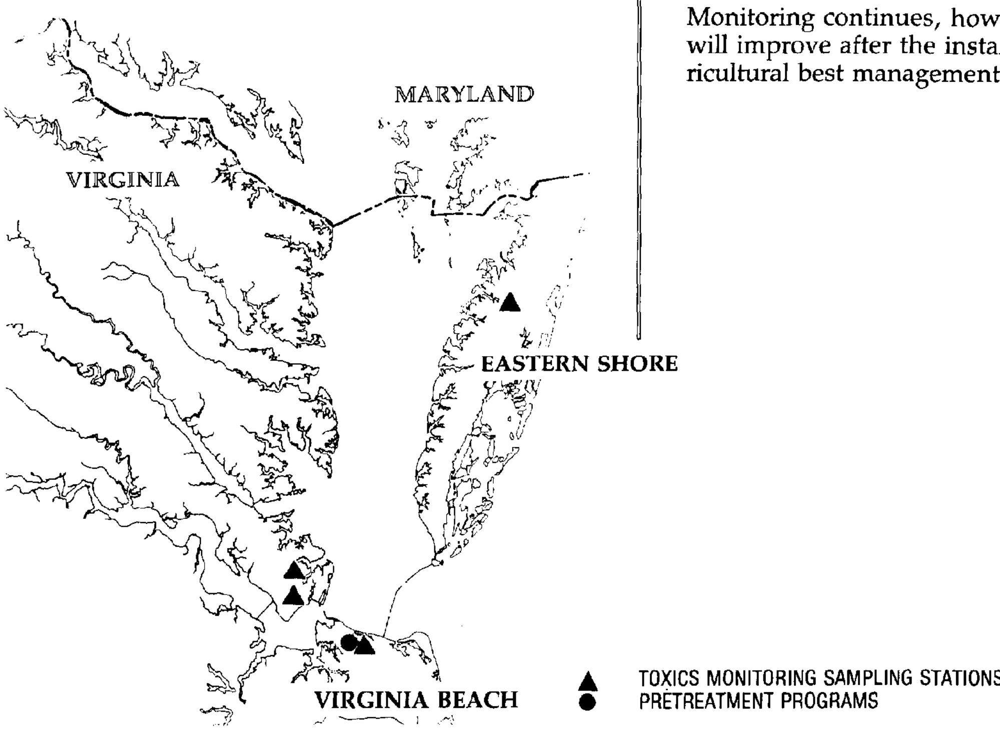


Figure 28. Sites of STPs with Toxics Programs

Resource and Habitat Improvement

Shellfish Enhancement

Since the Chesapeake Bay Initiatives program began in July 1984, fourteen shellfish growing areas within the minor tributaries or coastal embayments have been reopened to shellfishing. The reopened acreage, totalling 2067 acres, is a result of corrections to residential sanitation systems either by grants to low and moderate income households, or by Health Department enforcement efforts. Two other growing acres totalling 188 acres have been reopened since July 1986: Back Creek and Occohannock Creek. See Table 1 for a complete listing of reopened areas and the market value of shellfish now available.

Assawoman Creek on the Eastern Shore has been an active target area of the Shellfish Enhancement Task Force. All deficient residential sanitation system violations have been corrected and efforts to modify animal farming practices are underway with cooperation from some farmers and the federal Soil Conservation Service. Water quality remains poor and is not acceptable for shellfish harvested for human consumption. Monitoring continues, however, and hopefully will improve after the installation of additional agricultural best management practices.

Water Quality and Monitoring

Overview of Water Quality in Virginia's Major Tributaries

The major rivers in Virginia have very different patterns of development and land use in their basins which contribute to the differences seen in the water quality characteristics of these rivers. The annual cycles of freshwater flow and nutrients further combine to give each river it own characteristic water quality. These differences among the rivers are important in understanding each river and developing appropriate management strategies.

The upper reaches of the Potomac River have the highest nitrogen levels of any of the Virginia rivers but all of the rivers have similar concentrations at their mouths. Total phosphorus is high at the fall line of the Potomac and James Rivers and then increases in the tidal fresh zones. The Potomac River phosphorus levels remain high further downstream than in the James River. The York and Rappahannock Rivers are fairly low in both nutrients, with higher concentrations seen in the upper reaches of the Rappahannock and the lower reaches of the York River. Chlorophyll-a concentrations are highest in the highly urbanized tidal freshwater Potomac River. The James River experiences more algal production than the Rappahannock or York Rivers but not as great as the Potomac. The dissolved oxygen concentrations are affected by both natural occurrences such as the stratification in the Rappahannock and York Rivers and anthropogenic impacts as seen in the upper James and Potomac Rivers.

Water Quality Conditions of the Mainstem of the Bay for 1984 and 1985

The amount and timing of freshwater flowing into the Bay dramatically influences the nutrient and dissolved oxygen levels of the whole Bay system. The majority of the freshwater flowing into the Bay is contributed by the Susquehanna, Potomac, and James Rivers. Freshwater inflow from the winter through the summer of 1984 was above the 30 year average. From the fall of 1984 through much of 1985, the flow was generally well below the long term average. Hurricane Juan in November 1985 dramatically increased the freshwater flow, especially in the lower Bay.

Nitrogen concentrations in the mid Bay appear controlled by the transport of nitrogen, especially nitrate, from the upper Bay. Nitrate concentrations were high during the summer of 1984 and again during the winter and early spring of 1985 due to increased freshwater flowing in to the upper Bay. The nitrogen concentrations in the lower Bay appear to be more controlled by local storm events than by the transportation of nitrogen from the upper Bay. During periods of low oxygen the sediments can release ammonia-nitrogen which is an important nutrient controlling algal production.

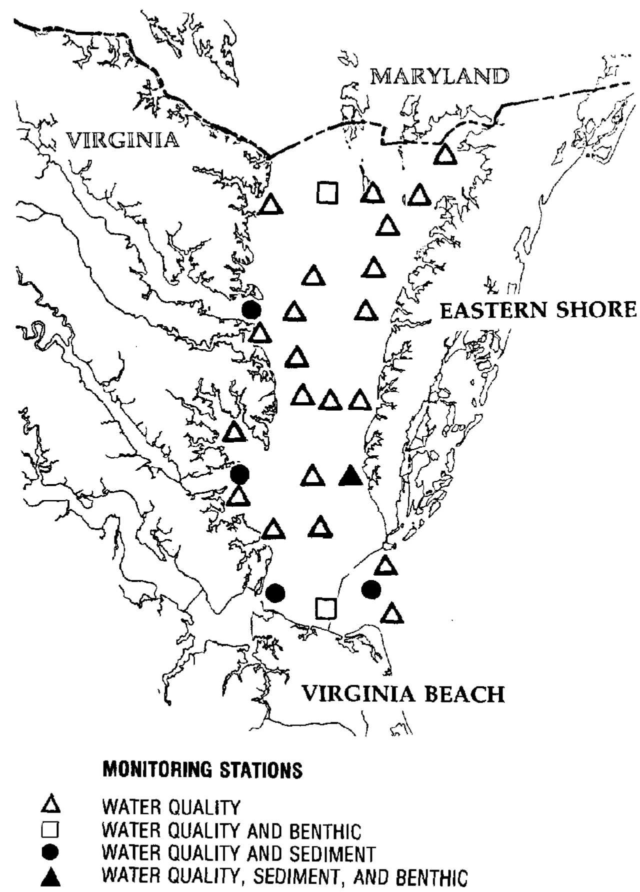


Figure 29. Monitoring Stations of Embayments and the Bay Mainstem

Phosphorus concentrations in the Bay are quite variable and usually lower than seen in the tributaries. As with ammonia, orthophosphate is released from the sediments during low oxygen conditions in the summer. These released nutrients are important in the nutrient cycles controlling algal production.

Chlorophyll concentrations in the mid and lower Bay are relatively low. It typically reaches a maximum during the spring peak in freshwater flowing into the Bay but the high flow conditions of the summer 1984 resulted in chlorophyll concentrations (15-30 $\mu g/l$) in certain areas of the mid Bay region.

The high freshwater flows in the summer of 1984 resulted in an overall decrease in salinity and an increase in the vertical stratification of the water column. This increased stratification limited the mixing of the lower high salinity layer and the upper low salinity layer. This resulted in low dissolved oxygen in the main channel as far south as just off the Rappahannock River. In 1985 the area of low dissolved oxygen did not extend nearly as far south due to less stratification and more mixing of the Bay's waters.

Plankton and Benthos Organism Monitoring

In addition to initiating water quality monitoring in the Bay and its tributaries, the Chesapeake Bay Program has been developing extensive biological monitoring programs for the Bay. The biological programs sample many of the same stations and close to the same time periods as the water quality monitoring program. This will help establish the links between the quality of the water and the organisms living within it.

During March 1985 the first samples were collected for the Benthic Monitoring Program. This program studies the bottom dwelling organisms such as worms, snails, and clams that provide food for many important species of fish. Through their presence or absence, these benthic organisms can also indicate the quality of the overlying water and the sediment in which they live. The benthos is particularly vulnerable to low oxygen conditions during the summer since most of these organism have little or no ability to move. Low oxygen conditions during the summer are believed to be adversely affecting the benthic organisms in the lower Rappahannock River and in the deep channel of the main Bay. During 1986 and 1987 additional sampling will be funded by the National Oceanic and Atmospheric Administration (NOAA) to study the extent of the problem.

Through a grant from the EPA, Virginia started to monitor plankton populations within the main Bay in July 1985. NOAA assisted the development and start up of a plankton program in the tributaries in March 1986. As of the end of the summer of 1986 the Commonwealth has combined and begun funding these two programs. The current program samples 13 stations up to twenty times per year.

Plankton are very small plants or animals carried by the currents of the Bay and the rivers. The algae, or phytoplankton, are vital to the complex food chain that supports the entire Bay but too much algae can create many problems. Excessive algae block light from other plants on the bay bottom such as eelgrass, and after dying, the algae consume large amounts of oxygen. The plankton also include zooplankton which are microscopic animals, eggs and larvae, that feed on the phytoplankton or each other. While a majority of the zooplankton are made up of very small creatures called copepods and cladacerans, many familiar animals also live part of their early life a part of the plankton, such as blue crabs, oysters, and many fish. The plankton are the base of the entire food chain in the Bay and react quickly to changes in the environment, either natural or man-made. It is vital to study these plants and animals in order to fully understand the complex nature of the Bay.

Water Quality Standards

Chlorine Standard

During 1986 the Virginia Water Control Board developed in-stream water quality standards for chlorine in both freshwater and estuarine waters. In freshwater, the standard requires that residual chlorine not exceed 19 parts per million (ppm) as an hourly average and 11 ppm for the daily average. For estuarine waters, chlorine-produced oxidants are not to exceed 13 ppm as an hourly average and 7.5 ppm for the daily average. These standards, which were adopted by the Board in June 1986, have no final implementation date, but all new and reissued discharge permits will include provisions to meet the standard. The VWCB staff is presently prioritizing the list of point source discharge permits in the State for implementation of the new water quality standard. One criteria for a higher priority is location of the facility in the Chesapeake Bay drainage area.

Nutrient Control Strategy

Until recently the problems of nutrient enrichment in Virginia's waters have been limited to localized areas, thus the management strategies that were developed were local or regional in nature. Examples include the Occoquan Reservoir in Fairfax and Prince William Counties, the Potomac

Embayments below Washington and the Chickahominy Watershed in the Piedmont region of the James River basin. Based upon the results of EPA's seven-year study which were published in 1983, the concerns over nutrient enrichment have broadened to include all of the Bay drainage area. Therefore, a comprehensive nutrient control strategy is required.

In 1985 the Virginia General Assembly established a special subcommittee, the Joint Subcommittee Studying Nutrient Enrichment in the Waters of the Commonwealth, to examine this issue. The 1986 subcommittee report recommended that the Virginia Water Control Board develop water quality standards to address nutrient enrichment problems in the Bay and its tributaries. The Board decided to expand their efforts state-wide and has since begun to develop these standards to cover all waters in the state and is scheduled to complete them by 1988. As with the development of any major regulatory action, there are a number of opportunities for the general public, the scientific community, environmental organizations and the regulated community to provide input towards the development and implementation of the nutrient standards. These standards will provide an appropriate regulatory mechanism for a state nutrient control program. With the continuing interest and work of the General Assembly Joint Subcommittee, the Commonwealth is now on course toward a comprehensive strategy that will address the nutrient enrichment problems and will provide a key element in the long-term restoration of the Bay and its tributaries.

Anti-fouling Marine Paints Containing Tributyltin (TBT)

Paints containing Tributyltin have in recent years become the choice product for retarding the growth of barnacles and other marine life on boat hulls. The pesticide in the paint slowly leaches out of the paint over a period of time ranging from one to five years. Because TBT paint is more toxic and lasts longer than other marine paints, the economic benefits are tremendous. But these benefits may not be great enough to offset the environmental costs.

TBT paint (tin-based) is 7 to 40 times as toxic to barnacles as traditionally used copper-based paint. It is lethal even at extremely low concentrations, measured in parts per trillion (ppt), to organisms other than those for which it has been targeted:

- Shellfish tend to bioaccumulate the toxins.
- As little as 15 ppt can be lethal to hard clam larvae.
- Paint particles inhaled while painting and scraping boat hulls may be harmful to humans.

Concentrations of TBT in Virginia waters have been found to be as high as 900 ppt. Many commercial marine vessels and an estimated 50% of pleasure craft use TBT-based paint.

The issue of TBT-based paint was brought to the forefront in the summer of 1985 when the Navy announced its proposal to use Organotin, a TBT-based paint, on its entire naval fleet. After reviewing the Navy's environmental assessment, Virginia's natural resources agencies led the nation in opposing the Navy's proposal until more research was done on the impacts of TBT on aquatic resources and human health. Congressional action followed with an amendment to the Navy's budget prohibiting the use of Organotin until the close of federal FY 1986. The prohibition was reinstituted for FY 1987 with a provision which allows the Navy to conduct limited boat paintings in waters outside Virginia.

Much scientific research has been initiated in response to the immediate concerns of the TBT antifouling marine paints. The Environmental Protection Agency is studying recreational and commercial uses of the marine paint and is also monitoring its amounts in the Chesapeake Bay. Study findings will be reported in the winter of 1986-87. In addition, the Virginia Institute of Marine Science is developing methods to detect TBT in minute quantities and is studying its effects on aquatic life, e.g., whether there is a correlation between the concentrations of TBT in Virginia waters and the decline of marine life in recent years. Some of this work is being done in conjunction with the Virginia Water Control Board.

The Virginia Water Control Board and the Council on the Environment has also asked the Virginia Department of Agriculture to no longer register the use of TBT in the Commonwealth.

In response to a Council on the Environment and Virginia Water Control Board recommendation, Governor Baliles has also requested the EPA to discontinue the registration (permitting) of TBT.

Financing Sewage Treatment Plant Construction and Expansion

The cost for future wastewater treatment needs in Virginia has been estimated at $2 billion. This includes new construction of wastewater treatment plants and sewer systems, upgrade or expansion of existing plants, and nutrient removal.

In an attempt to satisfy this need, the Virginia Resources Authority was created by the 1984 General Assembly and authorized to issue up to $300 million in bonds. In addition, the 1986 General Assembly appropriated $20 million in the FY

1986-88 biennium to capitalize the newly created Water Facilities Revolving Loan Fund (WFRLF). The VRA will administer the financial services required for the WFRLF and the Virginia Water Control Board will make policy decisions on the allocation of loans to localities. The General Assembly also provided $400,000 in the FY 1986-88 biennium to assist localities with a limited ability to pay for improvements. These funds may be distributed in the form of grants.

The following assumptions apply to the Revolving Loan Fund:

- An initial capitalization of $10 million in state appropriation combined with $50 million of federal funds for each year of a five year period;
- All funds are renewed immediately.

The $2 billion need can be met by the year 2009 if loans are made from the WFRLF at an 8% annual interest cost. Assuming a lower interest cost of 6% would produce $1.6 billion, and a 4.5% interest rate would produce $1.3 billion by the year 2009.

Fisheries Management

Virginia's marine fisheries have long been a valuable resource. Stocks of several commercially and recreationally valuable finfish and shellfish species inhabiting the Commonwealth's tidal waters have, however, been declining for some time. In an attempt to reverse this decline a number of Chesapeake Bay Initiatives and Bay-related activities have been developed to improve and protect the State's fisheries.

Fishery Management Plans and Regulations

Planning. In 1984, the Virginia General Assembly established an overall fisheries management policy and gave the Virginia Marine Resources Commission (VMRC) the authority to develop fishery management plans for the long term conservation and management of individual species. To accomplish these plans, a fisheries management division was created at VMRC. To provide citizen involvement in the planning process the Fisheries Management Advisory Committee was established with members representing both commercial and recreational user groups. The Committee has worked in an advisory capacity throughout plan development by providing assistance with the technical aspects of the problem as well as focusing public attention on fisheries management. Planning efforts are also being coordinated with Maryland resource managers.

Fisheries management plans have been under development for oysters and striped bass. Drafts of these plans have been completed and are available for public comment. They include strategies for increasing the stock of young oysters and str . bass, improving the available habitat, managing harvests, and ensuring the proper collection and management of fisheries data.

Regulations. In some cases, new or revised regulations are necessary to implement the management actions stated in the fishery management plans. For striped bass, the minimum size has been raised to 24 inches and the open season restricted to the time between June 1 and November 30. In another action, the authority to regulate oyster harvests is in the process of being moved from the General Assembly to the Virginia Marine Resources Commission which also regulates the other fisheries.

Oyster Repletion

The Virginia Marine Resources Commission (VMRC) has established an Oyster Repletion Program to enhance Virginia's public oyster fishery through the planting of oyster shell in oyster spawning areas and to transplant seed oysters to suitable growing areas. Historically this program was supported by the Oyster Rock Replenishment Fund, but a specific Chesapeake Bay Initiative appropriation was made to increase the repletion efforts by 50%.

During calendar year 1985, 1.8 million bushels of oyster shell and 26,579 bushels of seed oysters were planted in 18 different areas. During calendar year 1986, 2 million bushels of shell and 42,000 bushels of seed oysters were planted at 20 different areas.

Two new activities are being initiated during the 1986-88 biennium by the VMRC. A search for buried oyster shell that could be mined was begun. A local source of shell material is necessary for future program activity; this will reduce the need of importing shell from Maryland.

The second activity involves a process to "clean" shell previously planted which did not receive a good oyster strike. Because oyster larvae do not attach to fouled or sediment-covered oyster shell, the transplanted shell are turned over through the use of a dredge to expose their "clean" sides.

An evaluation of the 1984 oyster strike at planted sites indicated an average strike of 1000 spat per bushel. This is considered to be very good and is an indication that plantings were successful. Figure 30 shows public oyster harvests have been extremely dependent upon and highly correlated with oyster repletion activity.

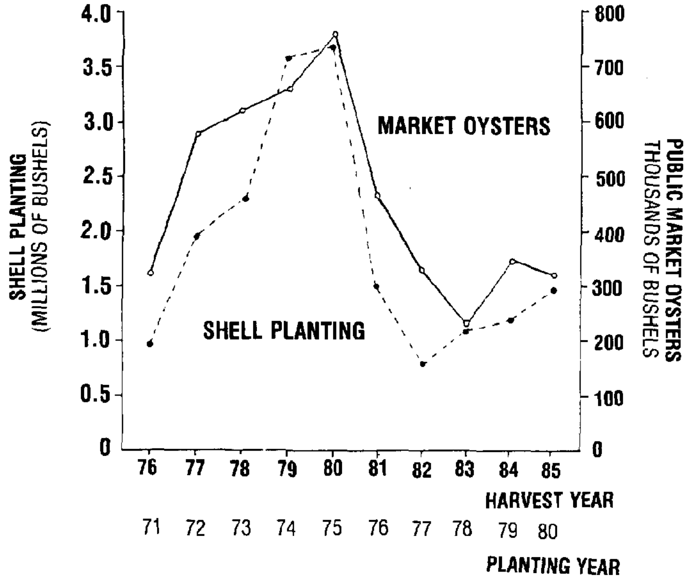
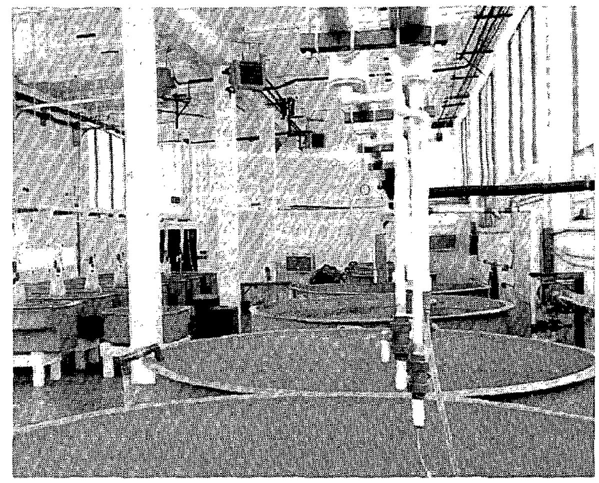


Figure 30. Relationships of Market Oyster Yield Shell Plantings Five Years Before Harvesting



An oyster hatchery has been established at the Virginia Institute of Marine Science.

Seed Oyster Hatchery

As one of the Chesapeake Bay Initiatives instituted in 1985, the Virginia Institute of Marine Science (VIMS) has built a seed oyster hatchery in an effort to stimulate oyster production in Virginia's waters. The institute is developing techniques for controlled oyster production for distribution to industry as a five-year pilot project.

Thus far cooperative tests have been accomplished with six individual watermen at their respective sites. In these tests a self contained trailer-mounted tank is taken to an individual's dock and filled with Bay water and bags of oyster shells. Oyster larvae are then placed in the tank and allowed to set, or attach themselves to the shells. The shells are then returned to the oyster bed or hung off a dock to harden. The oysterman, who has invited the test, then evaluates the demonstration and decides whether he would like to pursue the method further. To date, 18.6 million larvae have been distributed to individual industry representatives for these demonstrations.

During the early stages of an oyster's life, after it has set on an existing shell, it is very vulnerable to predators, poisoning, being smothered with sediment, and must suffer through many other difficult environmental factors found in an estuary. In an attempt to improve the survival rate of these young oysters, or spat, VIMS is conducting experiments to see what most often kills them in various estuarine environments. By determining which methods reduce mortality the most and at what size it is best to transplant the spat, researchers hope to produce a higher return on investment for the hatchery program. The program has a targeted production level of 500,000,000 oyster larvae for calendar year 1986.

Striped Bass Restocking

Virginia has joined together with Maryland in experimental efforts to stock Chesapeake Bay tributaries with native striped bass. An agreement signed between Virginia agencies and the federal government has moved the Commonwealth into an experimental restocking program.

Three Virginia agencies and the U.S. Fish and Wildlife Service are pooling their knowledge and resources to produce wild striped bass in hatcheries for release in their native streams. Participating with the Wildlife Service are the Virginia Commission of Game and Inland Fisheries, the Virginia Marine Resources Commission and the Virginia Institute of Marine Science.

The restocking program will involve catching spawning-run stripers in a Virginia river and transferring them to a state hatchery where they will be allowed to spawn. After the eggs are hatched, the young fish will be moved to a federal hatchery until they become 6 to 10 inches. They will then be returned to their river of origin where they will be tagged for monitoring and released. As many as 500,000 baby bass will be placed in Virginia tributaries to the Bay each year beginning in 1987.

The Commission of Game and Inland Fisheries regularly stocks Virginia's fresh water areas with a number of fish species including the striped bass. Some of the fish that are stocked in the rivers above the fall line manage to make their way downstream into salt water and therefore contribute to the Bay's striped bass population. The Commission has also stocked the tidal freshwater areas of the James and Chickahominy Rivers with a total of nearly 230,000 young stripers during the past two years. These also contribute to the Bay's fish population.

Spawning Grounds For Anadromous Fish

The Chesapeake Bay plays a critical role in the life cycles of many commercially and recreationally valuable fish species. Many, including croaker, spot and sea trout, use the Bay as a nursery area where young of the species spend much of their development periods before beginning their migratory patterns which take them out to sea and along the coast. Others spend virtually their entire lives within the Bay and its tributaries.

A number of valuable species spend most of their lives in saltwater but migrate to freshwater areas where they spawn and where the young hatch. Species which follow this pattern are called anadromous.

While general water quality improvements from the overall Chesapeake Bay cleanup program and ongoing state programs such as wetlands protection will benefit all species, anadromous fish require special attention. Their spawning areas are in the upper, freshwater portions of the estuaries, usually near the fall line, where population and development pressure tends to be high and pollution problems most intense. And, these species inhabit these areas at sensitive periods of their life cycles. Therefore, emphasis is being placed on projects in these areas, especially those to control the discharge of chlorine from municipal treatment plants. These projects are discussed under each river basin. Species that are year-round residents of these areas will also benefit.

Figure 31. Anadromous Fish Spawning Grounds

Fish Passage. Another problem facing anadromous fish is that their migration up river to spawn is often impeded or halted by dams which have no mechanism for fish passage. Many states have successfully enhanced or reintroduced anadromous stocks after long absences by constructing fishways at dams and restocking these species above the obstructions. Hundreds of miles of spawning habitat have been eliminated due to the construction of impoundments in Virginia rivers.

Feasibility studies to restore anadromous fish to their historic spawning grounds in Virginia rivers indicate that hundreds of miles of habitat could be restored on the major tributaries.

The Council on the Environment has recommended that state assistance be made available under Chesapeake Bay Initiatives for projects identified as having a significant impact on anadromous fishery stocks. A proposal will be developed for the 1988-90 biennium. As a first step, the Council recommends state financial assistance be made available to the City of Richmond for anadromous fish passage.

Freshwater Fish

The Commission of Game and Inland Fisheries manages the State's freshwater fisheries, including those which occur in the upper reaches of the tributaries of the Chesapeake Bay. All these fish are non-migratory.

Game fish managed for recreational use include:

- Sunfish
- Largemouth Bass
- Smallmouth Bass
- Catfish
- Pickerel
- Walleye
- Northern Pike
- Muskellunge
- Rock Bass
- Yellow Perch

Artificial Reef Development

The Virginia Marine Resources Commission has established artificial reef sites in order to create habitats to attract and increase the production of recreationally important fish species. This program began in the mid-1970s funded by unrefunded motor fuel taxes, but with specific funding through the Chesapeake Bay Initiatives. The amount of reef material deployed increased by about 40% in each year of the past two fiscal years.

Three reef sites continue to be added to each year:

- Parramore Reef—off the Wachapreague Inlet on Virginia's Eastern Shore
- Tower Reef—east of the Chesapeake Bay Light Tower
- Triangle Reef—east of Cape Charles

Other experimental reef sites are located in the Chesapeake Bay near Gwynn's Island and Cape Charles, and another in the Atlantic Ocean south of Wachapreague.

Approximately 1,700 tire modules, and 3,500 tire-in-concrete units accounting for over 400,000 square feet of reef substrate, were deployed during the 1984-86 biennium at the designated offshore sites. Of these, the tire-in-concrete units have been found to be the most successful. In addition, a surplus barge was sunk at the Tower Reef site.

Marina Pollution Abatement

The discharge of human wastes through boat toilets has often caused shellfish areas to be condemned in zones around marinas. In an effort to better understand some of the problems associated with controlling sewage discharges from boats and develop a more scientific method of establishing buffer zones around marinas, a new Chesapeake Bay Initiative has been introduced for the 1986-88 biennium. The Virginia Department of Health has designed a program to mitigate the problem. The program has three objectives.

One objective is to apply a quantitative method for establishing marina shellfish condemnation zones based on the flushing capability and physical characteristics of the marina location. Here, a numerical model will be constructed to consider the ability of marinas possessing similar geographical conditions to assimilate or flush contaminants for the purpose of determining the size of the condemnation zone needed around the marina. Within this zone, shellfish can not be harvested or sold to the public.

Another objective is to determine what impact the chemicals contained in boat holding tank wastewater may have on septic tanks and other sewage treatment systems. The Health Department is seeking sites to use for field studies on this issue. If no suitable sites can be found, experiments will be conducted in a laboratory.

The final objective of this initiative is to determine the feasibility of a voluntary no-discharge zone program. Under this program, boat owners would be informed of certain areas where they could not discharge treated sewage into the water. The Health Department wants to test the feasibility of a voluntary program by distributing information on no-discharge zones and then surveying boatowners as to their knowledge of and compliance with the zones.

The Health Department is also revising regulations concerning requirements for marina sewerage systems and pump-out facilities for boat holding tanks.

Commercial Public Landings

Public docks provide convenient landing facilities for Virginia watermen to land and unload their seafood catches. As part of the Chesapeake Bay Initiative program, the Virginia Marine Resources Commission has surveyed the Commonwealth's public docks to determine their condition and need for maintenance. In an effort to improve the access and quality of these landings, the Virginia Department of Highways and Transportation then completed repairs and restoration activities on 12 landings as illustrated in Figure 32. They have also erected approximately 46 signs identifying landing sites. More landings are slated for improvements in the 1986-88 biennium.

LANDING SITES TARGETED FOR MAINTENANCE AND REPAIRS

1. King's Landing
2. Timber Dock Landing
3. Seaford Landing
4. Guinea Landing
5. Williams Landing
6. Forest Landing
7. Rowe's Landing
8. Shipping Point Landing
9. Crane Creek Landing
10. Farnham Landing
11. Jones Creek Landing
12. Totuskey Landing

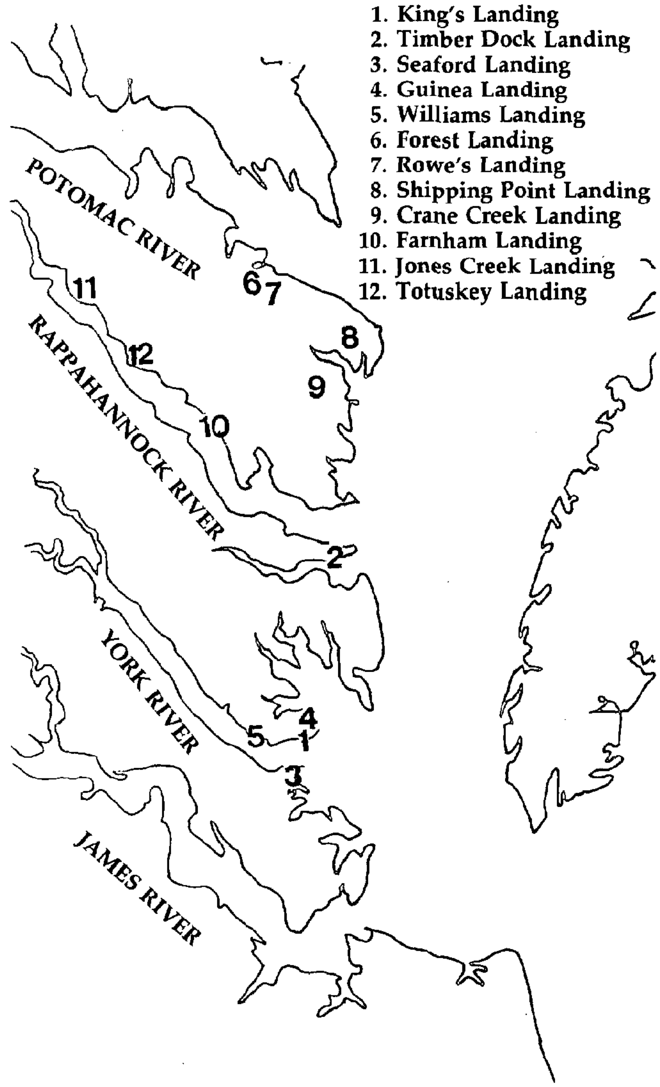


Figure 32. Public Landing Sites Rehabilitated in 1984–86

Research

Research provides the scientific information necessary to identify and understand the factors that affect the Bay's resources. It is the foundation from which many management and implementation strategies are developed. The emphasis of the Chesapeake Bay Initiatives research in Virginia has been on factors and processes influencing the productivity of oysters and finfish and the detection, fate and effects of chemical poisons in the Bay. Conducted at the Virginia Institute of Marine Science, this research addresses existing or anticipated resource management issues.

Oysters. Because the James River seed oyster beds are so important to the oyster industry in Virginia, the need for greater understanding of the factors affecting the recruitment of larvae to the seed bed area and their subsequent survival has been the basis of several research projects.

Water circulation studies conducted in the James River during 1984-86 suggest that these complex patterns play a vital role in the life cycle of the oyster and may be responsible for the noted productivity of the James River seed oyster beds. These findings and continuing research are being used in the development of a model that could be used for oyster management programs or predicting the effects of major dredging or filling projects on the circulation patterns.

In a separate but related effort, a three-dimensional computer model, originally developed for the Army Corps of Engineers, will be used to predict the movement of water and materials in estuarine water, and also to assess the potential impact of the proposed Newport Island development on the critical seed oyster beds. This project was initiated in Fall 1986.

Studies were also undertaken in the 1984-86 biennium to examine the sedimentation processes on oyster beds. The findings from this study will form the basis for development of site selection criteria to guide shell plantings, a method of enhancing oyster productivity by increasing substrate availability. The success of this replenishment strategy depends upon selecting areas not significantly impacted by siltation.

Other studies in the biennium included an examination of the effects of predators, fouling organisms, and chlorinated sewage on spatfall and spat survival and an evaluation of the sex ratios and genetic composition of the James River brood oysters.

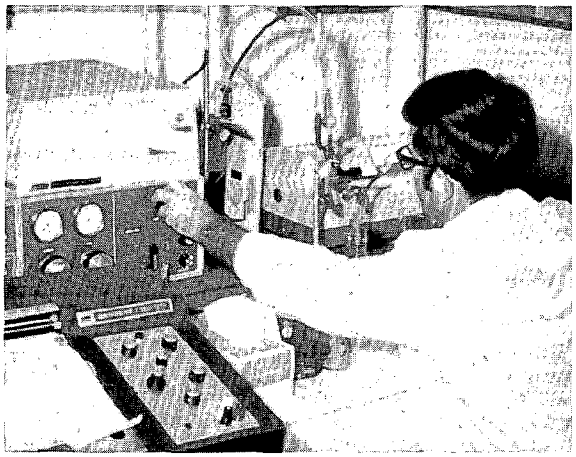
Critical Finfish Populations. The Chesapeake Bay is an important nursery area for flounder and spot, and recruitment of these species, which spawn on the continental shelf, is highly variable. Predictive models for recruitment of these species is being developed based on environmental factors and trends and cyclic components identified with recruitment. Other finfish studies involve the examination of factors which may affect striped bass survival during the early developmental stages of life such as predation and water chemistry.

Chemical Poisons. A major research achievement in the past biennium has been the development of a combined high performance liquid chromatography and mass spectrometry system. This analytical equipment, the only known one of its kind in the marine science field, will be used in research on the effects of chemical pollutants in the Bay system. Toxic chemicals may affect the reproductive processes and longevity of organisms which comprise Virginia's seafood resource. Because of the public health risk toxics contamination may pose, sampling of seafood from wholesale distributors has been started to provide baseline information on contamination levels. This information will be used along with other elements of on-going monitoring and research studies establishing a comprehensive monitoring program.

Kepone. A grant was awarded to the Medical College of Virginia to undertake a laboratory study of the potential of Kepone to cause liver cancer and to undertake the second five-year medical evaluation of former Life Science Products Co. workers who were exposed to this pesticide during the early to mid 1970s.

In 1985, the workers previously exposed to Kepone were tested and found to be in reasonably good health. Some patients did show some medical problems, however, and they will be re-evaluated in two years, rather than the five-year follow-up.

The final results of the laboratory study are not expected until 1988. Researchers are trying to determine if Kepone promotes tumors and in what doses it causes adverse health effects. This information will assist governmental decision-makers in their evaluation of the impact of dietary exposure by consumers. To date, evidence from the laboratory study supports the idea that Kepone may promote tumors, and may have the potential of being a true carcinogen.



Advanced technology is being used to study toxic problems in Chesapeake Bay waters.

Chesapeake Bay Estuarine Research Reserve. This past summer the governors of Virginia and Maryland agreed to work together in developing a Chesapeake Bay Estuarine Research Reserve System. This program is designed to set aside a network of sites in each state, representative of the various environmentals of the Bay and its tributaries, for the purposes of research, education and monitoring of natural processes, and for appreciation of future generations. The site selection process is expected to begin early in 1987.

Education

Much effort is being put into informing Virginia's citizens of the Bay's problems and potential solutions. Chesapeake Bay Initiatives educational activities are targeted for the general public, citizen groups, young Virginians, and farmers and include the use of a variety of different educational techniques.

Public Information. A number of brochures, reports, and other publications concerning the Chesapeake Bay have been prepared and made available to the public by various public and private organizations. Information is available on the status of the Bay cleanup and restoration efforts, what steps citizens can take to help the Bay, and on special technical issues. General information brochures are also available in quantity for meetings of groups interested in the Bay.

The public is also informed through the many presentations given by public and private environmental leaders across the Commonwealth. Further details on what information is available can be obtained by contacting the Council on the Environment.

Public Television Programs. Public television station WHRO of Norfolk has produced a sixty-minute documentary entitled "The Bay, Preserving the Future" with Chesapeake Bay Initiative Funds. While celebrating the beauty of the Chesapeake Bay, the program concentrates on the problems identified by the 1983 Environmental Protection Agency report and examines the efforts of states and private agencies in their efforts to clean up the Bay.

After airing on all of Virginia's public television stations in the Fall of 1986, the program will be made available to other Bay area states and then offered nationally via satellite for use in other states. It is expected that at least a quarter of a million people will eventually see the program.

The Council on the Environment and the Chesapeake Bay Commission, in conjunction with Cox Cable of Virginia Beach, are also producing a television documentary relating to the Bay. The program will examine the effects of various land uses on adjacent water quality and on the Chesapeake Bay.

Public Service Announcements. Radio and television public service announcements relating to the environmental conditions of the Chesapeake Bay have been produced. Three announcements, entitled "Phosphorous", "Rain", and "You Can Help" were developed and narrated first by Governor Robb and then by Governor Baliles.

The announcements advertise a toll-free number, 1-800-HELPBAY, and urge citizens to call and request additional information on the Bay. A variety of materials, including a brochure and fact sheets are sent to each caller. As of October 1986, approximately 1600 calls have been received in response to the ads as of October 1986.

Education Grants. The Chesapeake Bay Education Program has been initiated to fund educational programs on the Bay for Virginia citizens. The Council on the Environment has awarded a total of six grants during the 1984-86 biennium and other grants will be made in 1986-88. Over the next several years the diverse mix of projects chosen will reach millions of Virginians of all ages.

In awarding the grants, the Council chose projects which would reach audiences of different age levels, with particular emphasis placed on teachers and school-age children. This was considered important since the State's cleanup efforts are of a long-term nature. School-age citizens will, in the future, be making the decisions through business, industry, government and personal activities which will affect the health of the Bay. Another consideration was to select a mix of projects which would provide state-wide coverage of Bay issues.

An example of an education grant is the "Bay Team" visiting teacher program. Under this grant, direct classroom lessons are taught statewide by a visiting teacher. More than 15,000 students were reached in 1985-86.

Youth Conservation Corps. The Division of Parks and Recreation coordinates an initiative to make physical improvements on the condition of the Chesapeake Bay by employing disadvantaged youths for summer projects. In addition to helping clean up the Bay, the program provides an opportunity for youths to learn about the Chesapeake Bay environment and the problems it faces.

Projects have included shoreline stabilization and erosion control, marsh area improvements, trail construction, and waste site clearing. An example of a project was the City of Chesapeake's employment of 10 youths to remove debris, litter, and sediment from drainage areas and to construct a fish habitat. Another example was the City of Norfolk's employment of 12 youths to help stabilize dunes, build snow fences, and fertilize beach grass. The program employs approximately 150 disadvantaged youths each summer at a cost of about $200,000 and is scheduled to continue.

Bay Field Studies for Children. The Chesapeake Bay Foundation was funded by the General Assembly in addition to a Chesapeake Bay education grant to conduct an education program in Virginia during the 1984-86 biennium. The overall objective of the program was to give students an intensive, direct experience on the Chesapeake Bay to enhance marine science teaching and learning.

The first phase of the program involved the development of a marine science component designed around the *Standards of Learning-Science.*

The second phase of the program was directed to in-service teachers for working with the students in implementing a more comprehensive marine science program. Eighteen days of teacher training were offered during the year.

The third and final phase of the program involved field trips for students, along with teachers. Field trips consisted of boat trips on the larger Bay tributaries and canoe trips to small tidal fresh water tributaries. Students, working under the direction of teachers and other experienced educators, collected data, performed data analysis and conducted comparative studies.

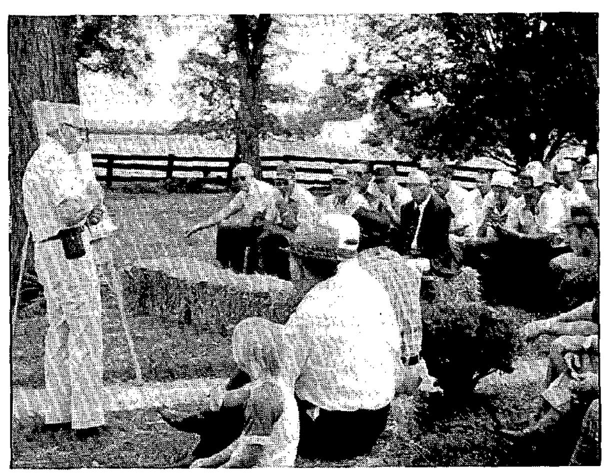
A total of 218 field trips were offered through this program with 5,662 students participating.

Encouraging Best Management Practices. The use of conservation techniques called Best Management Practices (BMPs) helps farmers retain their land's soil and nutrients and thus improves the water quality of the Bay. To encourage the use of BMPs, Virginia has initiated a number of programs to inform farmers of the benefits of these practices.

The Virginia Cooperative Extension Service conducts a general education program through its county extension agents within the Bay basin. The program includes farm visits, educational meetings, news articles, and radio programs. The Extension Service has also prepared brochures on the subject and developed a nutrient management demonstration program.

The Division of Soil and Water Conservation has a number of BMP educational programs. Grants have been made to local Soil and Water Conservation Districts (SWCD) to conduct education programs and tours. A Clean Water Farm Awards Program has also been developed to recognize those farmers who are properly managing their soil and nutrient resources. Research and demonstration programs have played an important educational role with 16 installations of 11 different types of innovative BMPs serving as focal points for many SWCD tours. An example of a demonstration program is the rainfall simulator which emphasizes strong visual differences between no-till and conventional-till farming.

Educational programs inform young Virginians about the Chesapeake Bay.



Farmers and local officials learn about Virginia's Chesapeake Bay Program through informal meetings.

In-State Management

The Council on the Environment provides overall state-wide coordination of Virginia's Chesapeake Bay cleanup efforts. It monitors progress on the various Bay initiatives, develops new initiatives, and acts as a liaison between the public and the state agencies involved in the Bay program.

In order to better manage the Commonwealth's data on the Bay, the Virginia Water Control Board and the Virginia Marine Resources Commission are in the process of automating and updating their data processing capabilities. Integrated data management systems are nearly complete and some are already in use.

The Virginia Marine Resources Commission is computerizing information on licensing, fishery statistics and harvest information, and oyster harvest and tax information. The information is being used in a number of ways including facilitating the creation of fishery management plans.

The Virginia Water Control Board is coordinating the collection and analysis of Chesapeake Bay water quality, sediment, and benthic monitoring data. They share the data with other Bay area states and the EPA through the Chesapeake Bay Program Computer Center at Annapolis.

In addition to data management, the Commonwealth also helps manage marine patrol efforts. The Marine Patrol Initiative reimburses Tidewater localities for a portion of their marine law enforcement, safety, and rescue operations expenses, and provides support for the Virginia Marine Resources Commission's marine dispatch operations.

Coastal Resources Management Program

The Virginia Coastal Resources Management Program (VCRMP) received final formal approval from the National Oceanic and Atmospheric Administration in September 1986. As a participant in the federal Coastal Zone Management Program the Commonwealth has received $1 million with the probability that a like sum will be available in each of the next five years.

Virginia has taken the network approach to coastal resources management with the result that the program relies almost entirely on existing regulatory programs. That management network is bound together by the new VCRMP Executive Order and is coordinated by the Council on the Environment with oversight by the Secretary of Natural Resources and the Governor.

The $1 million has been allocated in the following manner:

1) $500,000 for assistance to planning districts and local governments of the coastal area:
   - $340,000 to the planning districts to help support staff positions to provide technical assistance to the districts and their member local governments for matters related to coastal resources management.
   - $160,000 to local governments for non-construction projects relating to coastal resources management.
2) $434,580 for assistance to state agencies to supplement existing coastal resources management efforts:
   - $359,580 to the Virginia Water Control Board to develop new water quality monitoring and analytical capabilities.
   - $75,000 to the Department of Health to evaluate the feasibility of developing a private sector program for monitoring the application of sewage sludge to agricultural lands.
3) The remaining funds will be used for VCRMP-related administrative responsibilities and public information and participation activities.

A process for distributing funds to the coastal area planning districts and local governments began in Fall 1986. An advisory committee has been created to assist in the development of subgrant criteria and application of those criteria to subgrant requests.

Land Use Roundtable

A Land Use Roundtable was established in 1986 to begin to address the difficulties local governments often face in dealing with land use problems. The Roundtable is an informal assemblage of individuals with varied associations—local and state government, the legislature, the Chesapeake Bay Commission, real estate and development, finance, and conservation, and is staffed by the University of Virginia's Institute for Environmental Negotiation. The current focus of the group is to study the effects of land uses on adjacent and downstream waters and on the legal and institutional mechanisms available as solutions.

Shoreline Erosion

Virginia is graced with over 5000 miles of tidal shoreline ranging from barrier islands to ocean front beaches to the marshes and cliffs of the Chesapeake Bay and its tributaries. All of these shore types are affected by the natural process of erosion. Shoreline erosion occurs when land is washed away by the actions of storms, waves, and tides. Problems arise from this process when it compromises man's use of the shorefront.

Problems. From 1850 to 1950 the Commonwealth lost 21,000 acres of land to shoreline erosion. At present it is estimated that 330 miles of tidal shoreline suffer severe erosion at a rate of more than two feet per year. In some areas, the rate is as much as twenty feet per year. This means a loss of property for individuals, a loss of taxable land and public improvements for localities, and an influx of eroded sediments into the Bay. The loss of land is, however, by far the largest problem created by shoreline erosion. The amount of eroded shoreline sediments is actually a rather insignificant pollutant when compared to the quantity of sediments deposited into the Bay from runoff and erosion of upland rivers.

Most individual efforts to mitigate shoreline erosion consist of a property owner using some technique to protect his property. It has been shown, however, that the preferrable way to address the problem is on a reach basis. A reach is a continuous section of shoreline that shares similar composition and orientation characteristics. While individual efforts may protect a single piece of property, they may also accelerate the erosion process for nearby properties. In many cases this will then cause the original protection device to fail and the entire reach to deteriorate.

Solutions. The Commonwealth of Virginia has organized efforts to mitigate shoreline erosion. An umbrella organization, the Shoreline Programs Section of the Division of Soil and Water Conservation, has been created to coordinate these efforts. Its initiatives include:

- Technical assistance program for private waterfront property owners,
- Funding and technical assistance to help protect or restore public beaches,
- Research to determine the best ways to deal with the problem.

The Shoreline Erosion Advisory Service (SEAS), within the umbrella organization, provides technical assistance to owners and prospective owners of waterfront property concerning shoreline erosion. The agency provides data on historic erosion levels for properties, makes recommendations for the techniques best suited to control erosion there, recommends where on a property to build a house, and estimates prospective costs for protecting the land. In addition, assistance can be provided with the regulatory permitting process and with arranging contractor bids for construction. SEAS will also assist in the design of the recommended shoreline protection device and give further cost estimates if landowners decide to build a structure themselves. To encourage protection of an entire reach, SEAS urges individuals who consult the agency to work with their neighbors and coordinate their efforts.

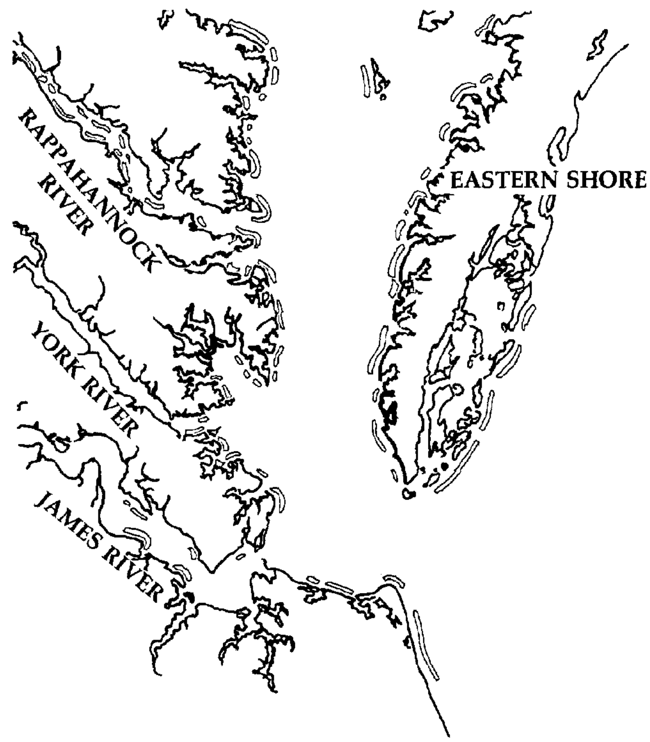


Figure 35. Shoreline Eroding at Greater Than Two Feet or More Per Year

A survey of users of the service taken in 1985 found that 100 percent of the landowners who returned the questionnaire found SEAS to be a valuable service and 60.3 percent actually carried out the recommendations. Since 1980, when the program began, SEAS has served 1,823 landowners. Their biennial operating budget was $282,219.

The Board for the Conservation and Development of Public Beaches determines which public beaches are suffering from erosion and provides money from a dedicated state fund to those localities most in need of relief. The Board also provides technical advice concerning beach erosion mitigation and restoration techniques. Advice can also be provided to localities with other coastal erosion problems. The Board's biennial budget of $1,262,000 included approximately $1 million for project grants such as beach replenishment.

Research into the Commonwealth's shoreline erosion problems is conducted by the Virginia Institute of Marine Science (VIMS). The Institute is researching the effectiveness of various erosion mitigation techniques in various shoreline situations. Recent research has included tests on marsh grasses and on the use of breakwaters. VIMS also monitors and documents the rate and extent of Virginia's shoreline erosion. Their biennial budget for research on shoreline erosion was approximately $188,000.

Citizen Participation

River Basin Committees

Citizen advisory committees were created in 1985 in an endeavor to provide thoughtful, long-term public participation in Virginia's Chesapeake Bay restoration efforts. The Virginia River Basin Citizen Committees for the Chesapeake Bay review Virginia's Bay Initiatives and other state programs related to the Bay, in light of the goals and objectives set for the Commonwealth's various river basins. There are approximately 150 committee members including people from local government, industry, agriculture, private non-profit groups, and marine trades. They are expected to recommend changes to state plans and programs designed to benefit the Bay for the 1988-90 biennium.

The Citizens Program for the Chesapeake Bay, under contract from the Virginia Council on the Environment, provides staff support for the committees. If citizens are interested in becoming involved with a River Basin Committee, they can obtain more information by calling (804) 225-4355. The eight river basin committees are indicated on Figure 34.

Citizen Monitoring

A volunteer citizen monitoring program has been started by the Citizens Program for the Chesapeake Bay on the James River in Virginia and the Patuxent River in Maryland. The purpose of the program is to determine whether volunteers can collect reliable water quality data which will enable managers to predict and assess long-term trends in the ecology of the Bay system. Data is being collected on five water quality factors at 12 sites on the James and 17 sites on the Patuxent.

Results obtained from the program so far indicate that the trained volunteers are collecting accurate, reliable data. When compared with data collected at nearby stations by state agencies, the volunteers' data has been shown to be very similar.

If successful, programs such as this could prove to be very valuable in building public support and understanding of Bay restoration efforts. A similar program on the Conestoga River in Pennsylvania is scheduled to start in late 1986.

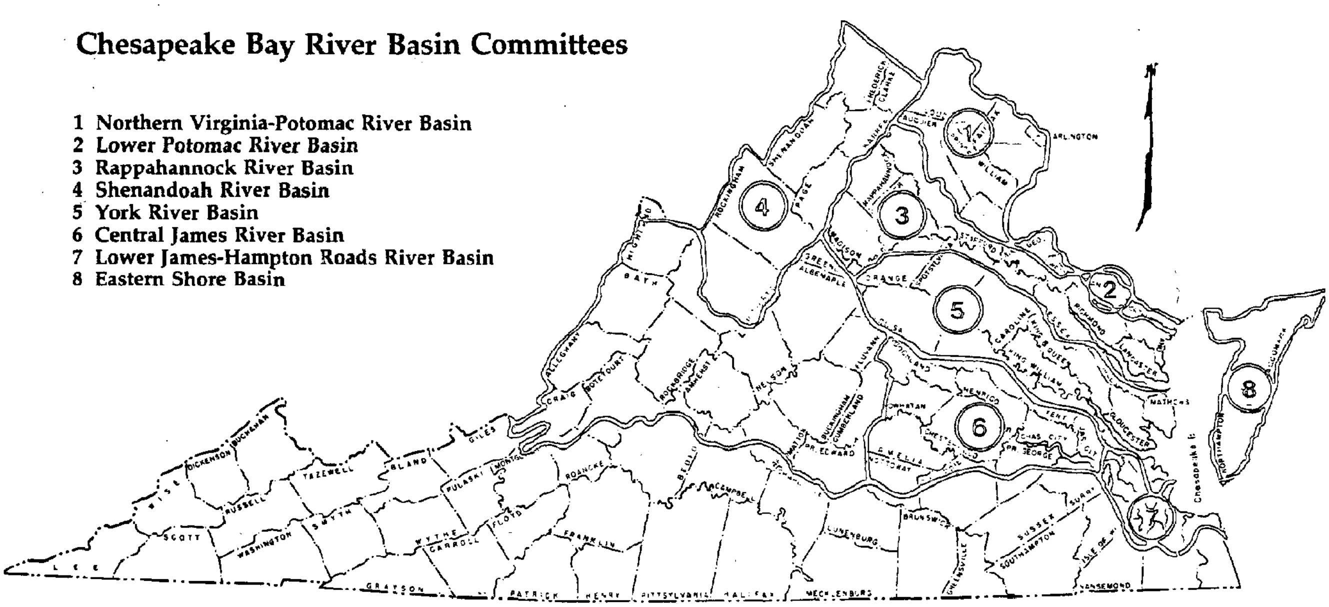


Figure 34. River Basin Committees for the Chesapeake Bay

Private Environmental Groups

Private environmental organizations concerned with the Bay such as the Lower James River Association, the Environmental Defense Fund, the Chesapeake Bay Foundation, Sierra Club, Audubon, and numerous others, are informed of the various Chesapeake Bay Initiatives and coastal issues through informal meetings with Council on the Environment staff, Council quarterly meetings, and through periodic mailings. Through these avenues, the Council has established effective channels of communication with Virginia's environmental groups. In return, the organizations often contact the Council or share their own newsletters of issues that they feel are important concerning Virginia's environment.

Inter-state Coordination

Efforts are being made to coordinate Chesapeake Bay clean-up initiatives on a regional basis. The Chesapeake Bay Commission, created in 1980, provides a forum for legislators, cabinet secretaries, and citizens from Virginia, Maryland, and Pennsylvania to discuss Bay matters from a legislative point of view. The Commission identifies significant Chesapeake Bay issues and develops recommendations for legislative action. It also conducts biennial evaluations of Bay conditions, programs, and management.

Another regional coordination group, the Chesapeake Executive Council, was created in December 1983 as a result of the Chesapeake Bay Agreement. It is a cooperative state and federal structure that provides a forum for cabinet level discussion of key matters relating to the Chesapeake Bay. The Council's membership includes cabinet and department secretaries from Virginia, Maryland, Pennsylvania, and the District of Columbia and the EPA regional administrator. It advises EPA on the use of EPA-Chesapeake Bay funds and guides the continuing development and annual refinement of the Chesapeake Bay Restoration and Protection Plan.

1985 and 1986 Bay Progress Reports

Several important changes need to be pointed out between *Virginia's Chesapeake Bay Initiatives First Annual Progress Report* (September 1985) and this report, *Progress Report of Virginia's Chesapeake Bay Program* (December 1986). More sophisticated techniques and methods are available to derive estimates and another year of data is available. The changes instituted in this document report more accurate information and improve our ability to assess trends for future strategies.

Nutrient Loading Charts. The 1980 nutrient loading figures stated in the 1985 progress report were derived from EPA sources. The river basin totals included adjacent coastal tributaries that were not actually part of that drainage basin. Virginia's 1986 progress report of nutrient loadings for 1980 are, hence, revisions with separate estimates provided for the Eastern Shore and minor coastal tributaries.

Water Quality Conditions. The water quality data reported last year for each river basin water quality was correct but did not represent a full year's monitoring since the program was just beginning. The data in the 1986 progress report represents average summer conditions for 1984 and 1985. This period was selected since the lowest oxygen levels and the highest chlorophyll-a levels typically occur during the summer. This period will continue to be used in the future as a measuring point. Therefore, the data charts in this report differs from those in the first progress report.

Chlorophyll-a has been added to the water quality charts in 1986 as a measure of light penetration. No chlorophyll-a data was available for most Virginia rivers prior to the summer of 1985. Chlorophyll-a is an indirect measurement of algae production in the water column. High algal production reduces light penetration and may reduce oxygen levels. The algal production can be directly linked to the levels of nitrogen and phosphorus.

Phosphorus Load Reductions. The level of phosphorus loading to Bay waters from agricultural sources is being monitored in order to assess the impacts of the State's Best Management Practices cost-share program. The 1985 progress report used 1983 EPA Chesapeake Bay Study Report data for base year comparisons. The model used to calculate these figures, however, has been revised. More accurate agricultural load reduction potential figures are used in Virginia's 1986 progress report, as calculated by the Division of Soil and Water Conservation, and are reflected in the new charts.

How You Can Help

The Chesapeake Bay cleanup program is tremendous in scope with concentrated state activities and region-wide efforts. At times it is difficult for individuals to see just what role they have or can have in the clean up program. It is, however, important that everyone contribute. Here are some ways each of us can contribute to the Chesapeake Bay restoration:

Stay Informed

- Contact local and state representatives to let them know your concerns.
- Report pollution incidents (illegal dumping, soil erosion etc.). To report a pollution incident, call the Virginia Water Control Board in your region.

Northern Office/Alexandria	703/750-9111
Piedmont Office/Richmond	804/257-1006
Southwest Office/Abingdon	703/628-5183
Tidewater/Virginia Beach	804/499-8742
Valley Office/Bridgewater	703/828-2595
West Central/Roanoke	703/982-7432

- Be aware of development and zoning changes in your community and how they may affect water quality and shorelines.
- Encourage the use of best management practices such as porous pavement, buffer strips, etc. in your community.

For Boaters

- If your boat is equipped with a marine sanitation holding device, use it!
- Use biodegradable bilge cleaner and empty bilges at pump stations only.

Water Quality

- Don't dump paint cleaners, antifreeze, pesticides down the drain. Use secure containers and dispose of them in the trash.
- Recycle your motor oil. Don't pour it down the drain or on the ground. There are a number of service station operators who will take your used oil. Call this toll-free number statewide: 1-800-552-3831.
- Use "no" or "low" phosphate detergents (it will tell you on the label) and wait until you have a full load to wash clothes.
- Use care when you use fertilizers, pesticides or herbicides to minimize runoff pollution. A little goes a long way! Call your local Agricultural Extension Agent for more information.
- Use lead free gas as airborne emissions from vehicles fall with precipitation back to the surface and into waterways.
- Properly maintain your septic system to prevent groundwater pollution.
- Bag or compost your yard clippings and leaves to keep them out of storm drains.
- Don't leave pet wastes on the ground to be washed away.
- Have gutters and downspouts drain into the grass or use a splash block to prevent erosion.

For further information contact:

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